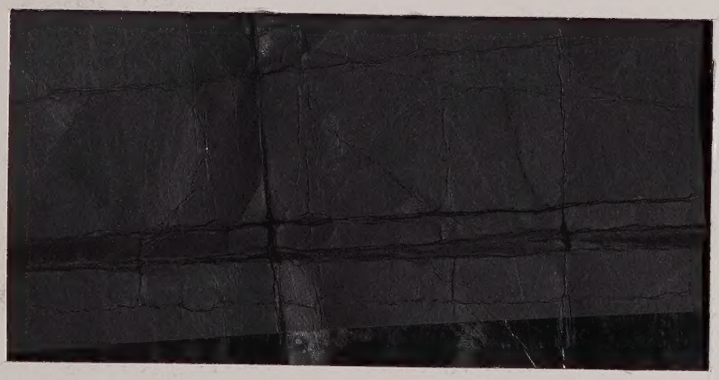

DRANETZ

MP MASTER
MA23002

WARNING

Because of possible shock or fire hazards, connection to this instrument should be performed in conjunction with the National Electrical Code (ANSI C1) and/or any other requirements which may be applicable to the user.

Installation, operation, and maintenance should be performed only by qualified personnel.

TM-103001

TECHNICAL MANUAL
OPERATION AND MAINTENANCE INSTRUCTIONS
FOR
UNINTERRUPTIBLE POWER SUPPLY
MODEL 910

Refer to Equipment Repair Order, Section V, if Factory repair is required.

Revised 15 August 1980

DRANETZ

DRANETZ ENGINEERING LABORATORIES, INCORPORATED
1000 New Durham Road, Edison, N.J. 08817, Tel. (201) 287-3680

STATEMENT OF WARRANTY

ALL PRODUCTS OF DRANETZ ENG. LABS., INC. ARE WARRANTED TO THE ORIGINAL PURCHASER AGAINST DEFECTIVE MATERIAL AND WORKMANSHIP FOR A PERIOD OF ONE YEAR FROM THE DATE OF DELIVERY. DRANETZ WILL REPAIR OR REPLACE, AT ITS OPTION, ALL DEFECTIVE EQUIPMENT RETURNED, FREIGHT PREPAID, DURING THE WARRANTY PERIOD, WITHOUT CHARGE FOR REPAIR, PROVIDED THERE IS NO EVIDENCE THAT THE EQUIPMENT HAS BEEN MISHANDLED OR ABUSED.

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

This manual provides operating and maintenance instructions for the Model 910 Uninterruptible Power Supply (hereinafter referred to as the Power Supply), manufactured by Dranetz Engineering Laboratories, South Plainfield, New Jersey. This section describes the purpose and technical characteristics of the Power Supply. (See figure 1-1.)

1-2. PURPOSE

The Power Supply is designed to provide a constant DC voltage for equipment requiring uninterruptible power sources. It is ideally suited for powering the Dranetz Series 606 Line Disturbance Analyzers. The DC output will remain within specified limits for all 'normal' line voltage conditions and for a minimum of 2 hours if the line voltage drops to a 'fault' condition. When the 'fault' condition is removed, the supply is capable of another 2 hours of 'fault' operation after at least 12 hours of operation from a 'normal' line.

1-3. DESCRIPTION

The Power Supply is configured as a small portable rectangular case-enclosed assembly equipped with a carrying handle and rubber feet. As shown in figure 1-1, the controls and indicators are grouped together at the upper section of the front panel. Heat sinks for the power transistors occupy the lower portion of the panel. Power input and output connectors are mounted at the rear of the unit. (See figure 2-1.)

Removal of the unit from its case exposes two printed circuit boards as well as the chassis mounted parts.

Figure 1-1. Model 910 Uninterruptible Power Supply

1-4. TECHNICAL CHARACTERISTICS

Table 1-1 lists the technical characteristics of the Power Supply.

TABLE 1-1. TECHNICAL CHARACTERISTICS

Input Voltage	
'Normal'	100-130 volts RMS or 200-260 volts RMS
'Fault'	Less than 95 volts RMS for 115V RMS nom. input Less than 190 volts RMS for 230V RMS nom. input
Input Frequency	47-450 Hz
Output	
Voltage	120-170 volts DC
Load current	0.2A for 80% duty cycle 0.8A for 20% duty cycle
Ripple	Less than 8 volts peak-to-peak
Temperature	
0° to 50°C	Full rating
-20° to 0°C	1 hour on battery
Transient Immunity*	180 volts max. for less than 1 second 1600 volts max. for less than 100 microseconds
Dropout time	During line to battery transition, output voltage may fall to 90 volts for no longer than 10 milliseconds.
Short circuit response	Output is capable of withstanding a short circuit. Either the main line fuse F1 or inverter fuse F2 may open.
Size	8" x 11" x 9-1/2" (18 cm x 28 cm x 24 cm)
Weight	35 lbs (16 Kg)

* During these transients, output voltage will not exceed 200 volts.

SECTION II

OPERATION

2-1. GENERAL

This section contains the procedures for connecting the Power Supply to the Series 606 Analyzer and powering the two units. For detailed information concerning Analyzer operation, refer to TM 102700, the Technical Manual for Series 606 Analyzers.

2-2. BATTERY INSTALLATION

The 12 volt battery (BT 1, P/N GC12200) supplied with the Model 910 Power Supply may be shipped in a separate container to avoid possible damage during transit. To install a separately packaged battery in the Power Supply, proceed as follows:

a. Remove four (4) screws from rear of Power Supply (adjacent to rubber feet).

b. Carefully slide power supply chassis out of case.

c. Remove card retainer screw, standoff, and printed circuit card No. 103010 from rear of supply.

d. Remove base plate by removing two (2) screws under lower front panel handle, and two (2) nuts from rear base plate studs.

e. Loosen, but do not remove, two (2) screws under upper front panel handle.

f. Remove battery from packaging and position on work surface with terminals on top pointing upwards.

g. Install permacel CR-12-SFR 1/2 X 1/2 inch foam adhesive material (supplied) as follows:

1) Apply 4" strips to top surface of battery on each side parallel to and 3/16" in from 5" edges.

2) Apply 4" strips to bottom surface of battery (Parallel to and 3/16" in from 5" edges).

3) Apply 5" strips to front surface of battery on each side parallel to and 3/16" from 7" edges.

4) Apply 6" strips to rear surface of battery - (Parallel to and 3/16" in from 7" edges).

h. Place battery inside Power Supply with 6-1/4" X 5" surface parallel to front panel, terminals forward. Battery must be centered to allow for assembly of case.

i. Connect red wire to ⊕ battery terminal and blue wire to ⊖ battery terminal.

j. Replace baseplate and assemble and tighten hardware, including screws under top handle.

k. Replace printed circuit card, standoff, and screw in rear of Power Supply.

l. Coat battery terminals with silicone grease.

m. Wipe side surfaces of battery with silicone grease to facilitate assembly.

n. Stand Power Supply on handles and carefully slide case over unit. Secure with previously removed hardware.

2-3. POWER SUPPLY CONTROLS AND INDICATORS

A single POWER switch and two indicators are located on the front panel of the Power Supply. The POWER switch applies AC input power to the unit. This switch also completes the battery circuit to prevent automatic power switchover when the Power Supply is turned off. The green LINE indicator glows whenever the power supply is on, regardless of mode. The red BATT indicator glows only when the internal inverter is being driven by the batteries.

2-4. CONNECTIONS

a. Position the Power Supply near the Series 606 Analyzer, set the Power Supply POWER switch to its off (down) position, and set the key switch on the Analyzer to OFF.

b. Verify that the line voltage selector switch at the front of the Power Supply is positioned to the correct line voltage — either 115 or 230. The line voltage selector switch is located between the two fuses and may be covered with a decal. If the Analyzer is equipped with Option 102, be sure its line voltage switch is set to the 115 volt position.

c. The power requirement for the Power Supply is 100-130 volts AC, 47-450 Hz (115 volt position of line voltage selector switch) or 200-260 volts AC, 47-450 Hz (230 volt switch position). Connect the power cord between the input power receptacle at the rear of the Power Supply and the AC power source. Now plug the Analyzer power cord into the output receptacle at the rear of the Power Supply. (See figure 2-1.)

2-5. POWER TURN-ON

a. Set the POWER switch on the Power Supply to the ON position. The green LINE indicator should glow.

b. Set the key switch on the Analyzer to the SET position. The green LINE indicator on the Analyzer front panel should glow.

NOTE

At this time, both the Power Supply and Analyzer are operational. No further operations need be performed on the Power Supply. If line voltage should fail, the red BATT indicator on the Power Supply will light. The Power Supply is designed to carry the Analyzer through complete source power interruptions for up to 2 hours without degrading performance.

2-6. POWER TURN-OFF

a. Set the Analyzer Key switch to the OFF position.

b. Set the POWER switch on the Power Supply to its off position.

c. Disconnect the Power Supply line cord from the AC power source. (The Analyzer line cord can remain plugged into the Power Supply.)

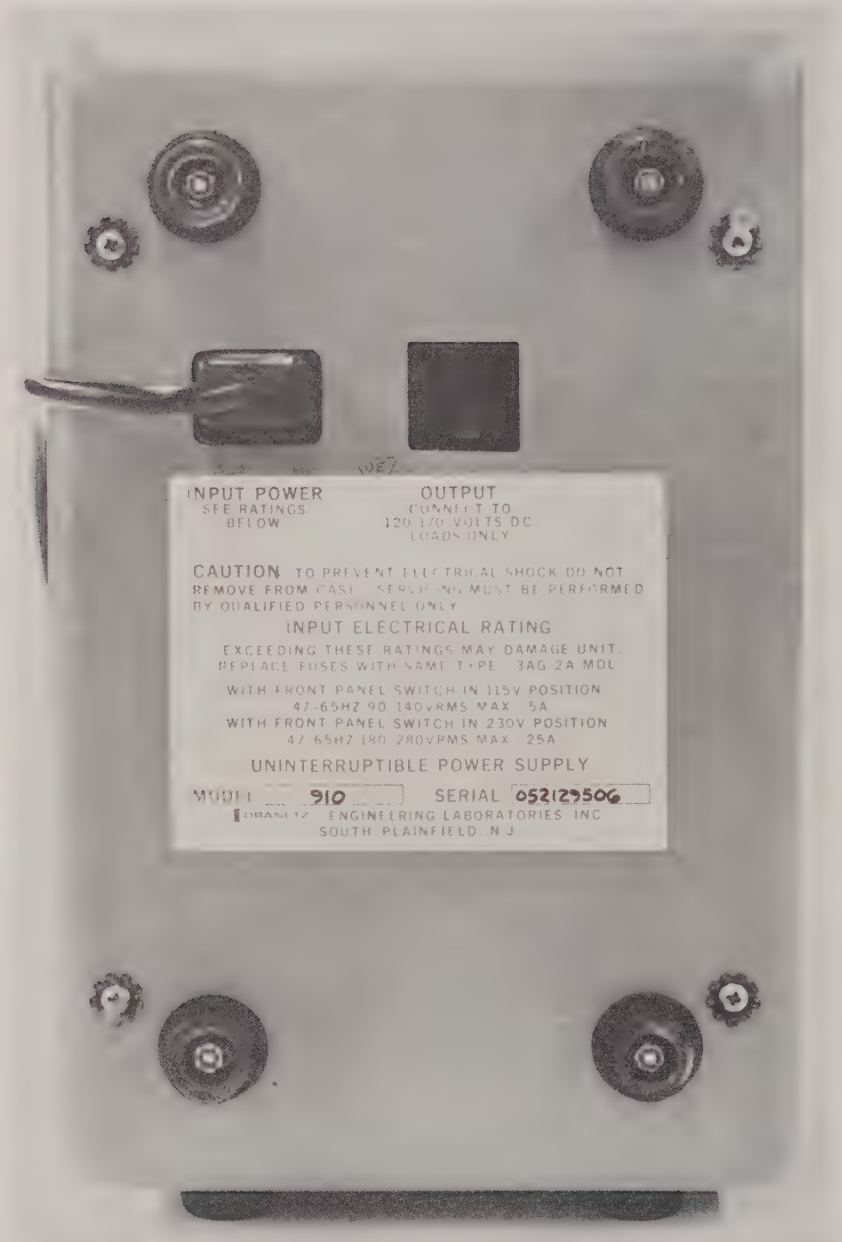

INPUT POWER
SEE RATINGS
BELOW
OUTPUT
CONNECT TO
120 170 VOLTS DC
LOADS ONLY
CAUTION TO PREVENT ELECTRICAL SHOCK DO NOT
REMOVE FROM CASE SERVICING MUST BE PERFORMED
BY QUALIFIED PERSONNEL ONLY
INPUT ELECTRICAL RATING
EXCEEDING THESE RATINGS MAY DAMAGE UNIT.
REPLACE FUSES WITH SAME TYPE 3AG 2A MDL
WITH FRONT PANEL SWITCH IN 115V POSITION
47-65HZ 90 140vRMS MAX 5A
WITH FRONT PANEL SWITCH IN 230V POSITION
47 65HZ 180 280VRMS MAX 25A
UNINTERRUPTIBLE POWER SUPPLY
MODEL 910
SERIAL 052129506
ENGINEERING LABORATORIES INC
SOUTH PLAINFIELD, N.J.

Figure 2-1. Power Supply, Rear View

SECTION III

PERFORMANCE CHECKS

3-1. GENERAL

The performance checks presented in this section will enable the user to determine if the Power Supply is operating properly. These tests can be performed after setting up the Power Supply or after servicing the equipment to verify that it is functional and meets the specifications listed in Table 1-1. Adjustment procedures for the two adjustable controls are included with the test procedures.

3-2. TEST EQUIPMENT REQUIRED

Table 3-1 lists the test equipment recommended for the performance tests and their specifications. In each case, equivalent test equipment may be used.

TABLE 3-1. TEST EQUIPMENT REQUIRED

Item	Specification	Recommended Type
Oscilloscope	-	Tektronix, Model 453
Digital Voltmeter	-	Fluke, Model 8300A
AC Voltmeter	0-250 volts	-
DC Ammeter	0-10 amperes	Weston, Model 931
Load Resistor	350 ohms, 120 watts	-
Variac	0-140V, 10A	General Radio, Model W8MT3

3-3. TEST SETUP

Remove the Power Supply chassis from its case by removing the four rear screws, then connect the unit into the test setup shown in figure 3-1.

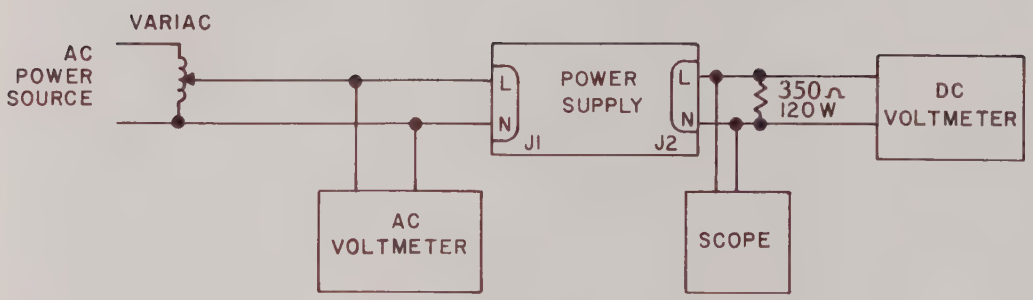


Figure 3-1. Test Setup

3-4. MAIN REGULATOR TEST

a. Set line voltage selector switch S2 at rear of Power Supply to 115V.

b. Set the POWER switch to ON.

c. Vary the 60 Hz AC input voltage from 100 to 130 volts RMS. The output voltage should be 120 volts DC minimum.

d. Increase AC input to 140 volts RMS. The output voltage should be 160 ± 5 volts DC.

e. Set AC input to 130 volts RMS and measure the ripple voltage across the load resistor. It should not exceed 8 volts P-P.

f. Set the POWER switch to OFF.

g. Reduce AC input to 0. Reset line voltage selector switch S2 to 230V.

h. Increase AC input to 200 volts RMS. Set the POWER switch to ON. The output voltage should be 120 volts DC minimum.

i. Increase AC input to 280 volts RMS. The output voltage should be 160 ± 5 volts DC.

j. Set the POWER switch to OFF.

k. Reduce AC input to 0 and reset switch S2 to 115V.

3-5. BATTERY CHARGER TEST

a. Set the POWER switch to OFF.

b. Connect the 0-10 ampere DC ammeter between the positive terminal of the battery and the battery charger output.

c. Set line voltage selector switch S2 to 115V.

d. Adjust the AC input voltage to 100 volts RMS and set POWER switch to ON.

e. Measure the DC output voltage of the battery charger. If the DC voltage is not between 13.5 and 13.8 volts, adjust A1R43 (fig. 3-2) for a reading of 13.5 volts DC.

f. Verify that the battery is charging by observing a positive charging current greater than 0.2 amperes.

g. Increase AC input voltage to 130 volts RMS. Verify that the battery charger output voltage is 13.5 to 13.8 volts DC.

h. Verify that battery charging current is 0.2 to 4.0 amperes.

i. Reduce AC input to 115 volts RMS and allow the battery to charge until the charging current decreases to less than 0.2 amperes.

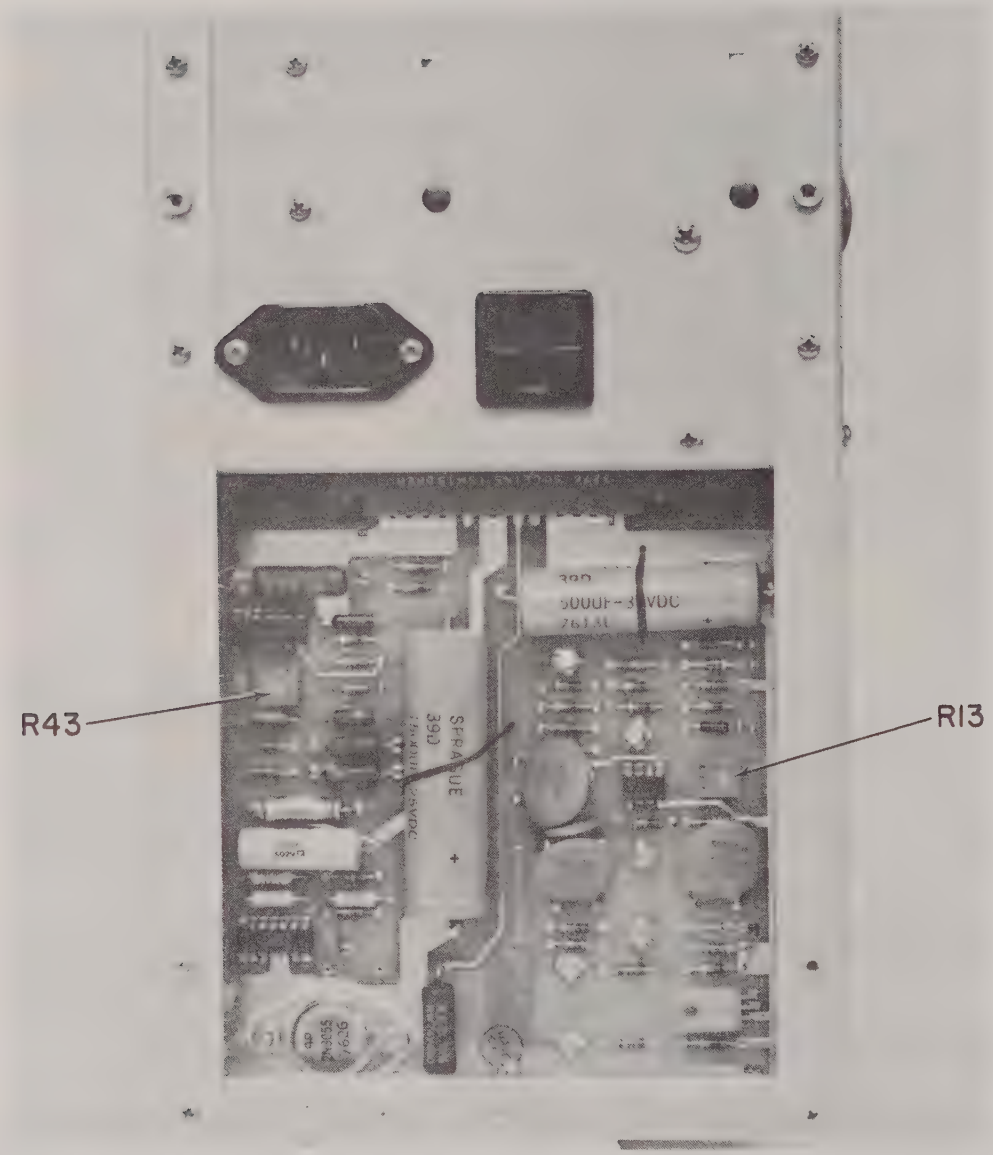


Figure 3-2. Location of Adjustments on PC Board A1

j. Set POWER switch to OFF. Leave DC ammeter connected to battery charger output.

3-6. INVERTER TEST

a. With line voltage selector switch set to 115 volts RMS, adjust AC input voltage to 115 volts RMS, then set POWER switch to ON.

b. Verify that inverter is off (red BATT indicator is off).

c. Set the AC input voltage to 100 volts RMS. If red BATT indicator lights, adjust A1R13 until the indicator goes out.

d. Reduce the AC input voltage to 95 volts RMS. Verify that the inverter comes on (red BATT indicator lights). If necessary, adjust A1R13 until the inverter comes on.

e. Repeat steps c and d until the inverter starts at 95 volts RMS and turns off at 100 volts RMS.

f. With the inverter operating, verify that main regulator output is 145 ± 10 volts DC.

NOTE

If the regulator output is less than 135 volts DC, the battery should be recharged.

g. Verify that the ripple voltage across the main regulator load is less than 8 volts peak-to-peak.

h. Let the inverter operate for 2 hours, then verify that output voltage is 120 volts DC minimum.

i. Set POWER switch to OFF.

j. Replace the 60 Hz AC input source with a 115 ± 5 volt 400 ± 10 Hz source and repeat the procedures of para. 3-4a through e and 3-5a through h.

k. Restore 115 volt 60 Hz input, and let the battery charge until the ammeter reads less than 0.2 ampere, then set POWER switch to off, remove ammeter and reconnect battery directly to battery charger.

l. Replace the Power Supply in the case.

SECTION IV

THEORY OF OPERATION

4-1. GENERAL

This section provides a functional description of the Power Supply. The discussion is referenced to figure 4-1, a block diagram in this section and to figure 7-1, the overall schematic diagram in Section VII.

NOTE

Except where noted, the following descriptions apply to 115 VAC 60 Hz operation.

4-2. OVERALL DESCRIPTION (See fig. 4-1.)

The Power Supply operates either from 115 volts RMS (nominal) or 230 volts RMS (nominal). Line voltage passes through front panel POWER switch S1, fuse F1, and line voltage selector switch S2 to power transformer T1 in the AC input circuit. The AC input circuit supplies the necessary voltages for the AC line bridge rectifier, main regulator, inverter, and battery charger channels of the Power Supply.

During normal AC line operation, the output of the AC line bridge rectifier is fed through series regulators Q2 and Q3 to the high voltage DC lines 'H' and 'D'. A floating regulator prevents the main regulator output from rising above 160 volts DC. The regulator operates from a DC supply (lines 'G' and 'H') that floats above the main regulator.

During normal line operation, the battery charger provides 13.5 volts DC (lines 'G' and 'H') for the main regulator and for the inverter channel. The battery charger consists of a conventional regulated supply (bridge rectifier, series regulators, and regulator driver). With the line voltage at 115 volts RMS (nominal) the battery charger maintains the internal battery in a charged condition.

The inverter channel provides an alternate means of driving the main regulator should the AC power line fail. A hold-off circuit monitors the DC level

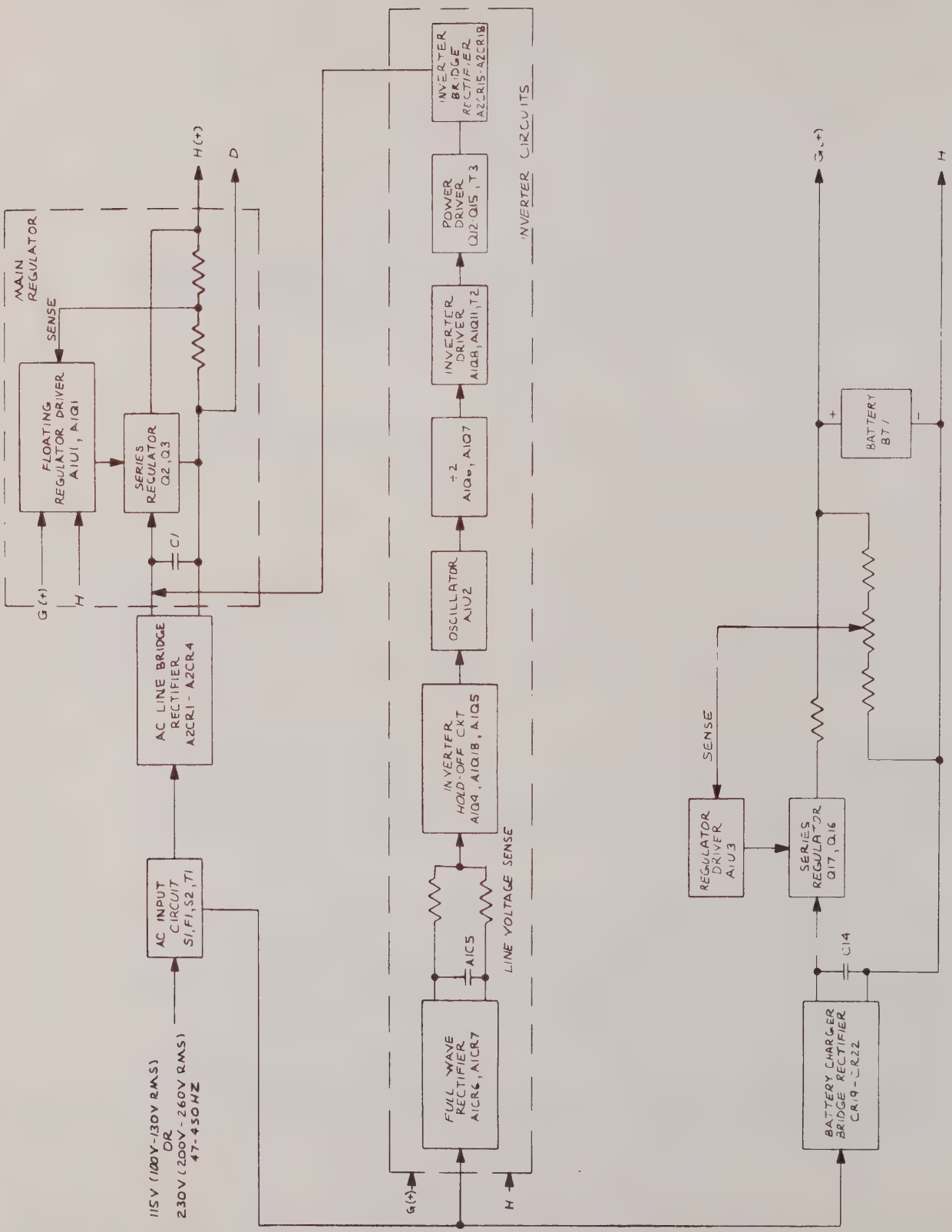


Figure 4-1. Power Supply, Block Diagram

supplied by full wave rectifier supply A1CR6, A1CR7, and A1C5. If the DC voltage corresponds to an AC line voltage in excess of 95 volts RMS (nominal), the hold off circuit maintains oscillator A1U2 in the reset state and the inverter channel remains off. If, however, the AC line voltage drops below 95 volts RMS, oscillator A1U2 is enabled and it generates 1 kHz pulses. These pulses are divided to 500 Hz, converted to square waves, amplified, and drive a bridge rectifier in the inverter channel. The DC output of this bridge rectifier then drives the main regulator.

During intervals of AC line failure, the battery charger is off and the self-contained battery provides the DC supply for both the inverter and main regulator channels.

4-3. DETAILED DESCRIPTION (See fig. 7-3)

4-4. AC INPUT CIRCUIT

The AC line voltage passes through POWER switch S1 and fuse F1 to line voltage selector switch S2 at the rear of the Power Supply. When S2 is set to 115V, the 115 volt (nominal) AC input is connected to terminals 2 and 3 of transformer T1 and through thermistor R2 to bridge rectifier A2CR1-A2CR4. Thermistor R2 limits current surges during filter C1 charging intervals. When operating from a 230-volt (nominal) AC power source, switch S2 is set to 230V and the AC input is applied across the full primary winding (terminals 1 and 3) of T1. The stepped down voltage developed across terminals 2 and 3 is then applied to full wave bridge rectifier A2CR1-A2CR4. In either case, 20 volts peak (nominal) is developed across the secondary winding of T1 for the inverter and battery charger circuits.

4-5. BATTERY CHARGER CIRCUITS

The battery charger consists of a conventional feedback regulator. The AC voltage developed at the secondary winding of transformer T1 is rectified by full wave bridge diodes CR19-CR22, developing a DC voltage across filter capacitor C14. This voltage is applied to A1U3, a voltage regulator configured as a foldback current limiter. The regulated DC voltage at A1U3-10 drives series regulators Q16 and Q17. Current from these stages passes through A1R53 which provides foldback current limiting. The DC output of the battery charger drives the main regulator and inverter channels during AC line operation. When the AC input is within the operating range of 115 ± 15 volts RMS, the battery charger output is regulated at 13.5 to 13.8 volts DC and the battery is float charged. If the AC input voltage drops below 100 volts AC, battery charging ceases. Green LINE indicator DS1 lights during either line or battery operation. Potentiometer A1R43 adjusts the battery charger output voltage.

4-6. MAIN REGULATOR

When the AC line voltage exceeds approximately 95 volts RMS, the inverter circuits remain off and the main regulator is driven by the DC output of AC line bridge rectifier A2CR1-A2CR4, developed across filter capacitor C1. (This voltage back biases bridge rectifier A2CR15-A2CR18 in the inverter channel.) The DC voltage across C1 is applied to the 'H' and 'D' lines via series regulators Q2 and Q3 which are controlled by regulator drivers A1U1 and A1Q1. The driver stages operate from a DC voltage (lines 'G' and 'H') which is floated above the main regulator output. During AC line operation, this voltage is 13.5 volts DC nominal supplied by the battery charger. During battery operation, the voltage, supplied by the self-contained battery, drops to 12 volts DC.

For line voltages between 100 volts RMS and 115 volts RMS, the regulator driver stages do not affect the DC output which ranges from approximately 120 volts DC to 160 volts DC. With line voltage levels between 115 VAC and 130 VAC, the increased voltage developed between the 'H' and 'D' lines causes the voltage at sensing input pin 5 of regulator driver A1U1 to decrease with respect to the internal reference generated at pin 6. As a result, A1U1 and A1Q1 reduce the drive to Q2 and Q3, regulating the DC output of the main regulator at 160 volts DC. This action restricts the main regulator output to between 120 volts DC and 160 ± 5 volts DC for line voltage inputs from 100 VAC to 130 VAC.

4-7. INVERTER CHANNEL

During normal AC line operation, the inverter hold-off circuit, consisting of complementary flip-flop A1Q4/A1Q18 and transistor switch A1Q5, inhibits inverter operation. Transistor switch A1Q5 is connected between the reset input pin 4 of oscillator A1U2 and common (pin 1). The AC voltage at the secondary of transformer T1 (nominally 20 volts peak) is full-wave rectified by A1CR6 and A1CR7, producing a DC voltage across A1C5 and parallel circuits A1CR5/A1R17 and A1R13/A1R14/A1R15. If the AC line voltage level exceeds approximately 95 volts, the DC voltage at the anode of zener diode A1CR5 biases A1Q4 on. Transistor A1Q4 conducts, turning on A1Q18 whose collector then drives A1Q4 further into conduction. With A1Q4 fully conductive, transistor switch A1Q5 is biased on, maintaining oscillator A1U2 in the reset (non-oscillating) state. With A1U2 off, the inverter remains off and the line voltage drives the main regulator through AC line bridge rectifier A2CR1-A2CR4.

If the line voltage drops below 95 volts RMS, the DC voltage at the anode of zener diode A1CR5 drops, conduction decreases in A1Q4, conduction decreases in A1Q18, and A1Q4 is biased off. The voltage level at which switchover occurs is adjusted by potentiometer A1R13. With base drive to A1Q5 removed, it is turned off, permitting A1U2 to oscillate. Short duration pulses at approximately 1 kHz, are developed at A1U2-3. These pulses are applied to divide-by-2 stage A1Q6/A1Q7. Square wave signals at approximately 500 Hz, developed at the emitters of A1Q6 and A1Q7, are fed through two-stage drivers A1Q8-A1Q11

coupling transformer T2, and resistors R32-R35 to power stages Q12-Q15. The power stages drive output transformer T3, the secondary winding of which provides high amplitude (140V peak) square waves to bridge rectifiers A2CR15-A2CR18 via fuse F2. If the battery is fully charged, the main regulator produces approximately 145 volts from its inverter drive.

The inverter circuits operate from the DC supply applied to the G(+) and H(-) lines. This supply is normally derived from the battery charger circuits, but during emergency intervals it is provided by the self-contained battery in the power supply assembly.

A red BATT indicator, DS2, driven by the power stages, lights during inverter operation to signify that the power supply is the emergency battery mode. The green LINE indicator is also turned on at this time.

SECTION V

MAINTENANCE

5-1. SCOPE

This section contains procedures and data that will help ensure continuity of service of the Power Supply. It provides troubleshooting and repair procedures necessary to locate and correct any faults discovered during testing or normal use. Personnel responsible for maintaining the Power Supply should be thoroughly familiar with its physical make-up and principles of operation before attempting to troubleshoot it.

5-2. TEST EQUIPMENT REQUIRED

The test equipment listed in Table 3-1 (Section III) is suitable for maintenance.

5-3. TROUBLESHOOTING

Table 5-1 provides data that should prove helpful when troubleshooting the Power Supply. Use this data in conjunction with the schematic diagram (figure 7-1) to isolate trouble to a defective part. If necessary, adjust the controls specified in the table. The electrical parts are identified in the Parts List, Section VI.

5-4. DISASSEMBLY

When required for service, the Power Supply may be easily disassembled by removing the four screws at the rear and pulling the unit out of its case.

TABLE 5-1. TROUBLESHOOTING CHART

Trouble Indication	Possible Cause
Line voltage normal, but Power Supply operates in battery mode	Line voltage selector switch improperly positioned
	Potentiometer R13 requires adjustment (See para. 3-6 for adjustment procedure.)
	Fuse F1 open
	Defective power transformer T1
	Defective thermistor R2 or bridge rectifier A2CR1-A2CR4
	Defect in inverter hold-off circuit
Power Supply does not operate in battery mode	Defect in inverter channel
	Batteries not charged
	Defect in battery charger circuit prevents battery charging during AC line operation. Check adjustment of potentiometer A1R43. (See para. 3-5.)
Power Supply output voltage exceeds 170 volts DC	Defect in high voltage regulator (Q2, Q3, A1U1, A1Q1).
Switchover to battery and/or back to line operation occurs at incorrect AC input levels	Potentiometer A1R13 requires adjustment. (See para. 3-6.)

5-5. FACTORY REPAIR

When factory repair is desired, proceed as follows:

1. Contact the Dranetz Engineering Customer Service Department and obtain an Authorization Number.

2. Fill out the Repair/Service Order enclosed in this manual and ship it with the equipment to the Customer Service Department.

CUSTOMER SERVICE DEPT.
DRANETZ ENG. LABS., INC.
2385 So. Clinton Ave.
So. Plainfield, N.J. 07080

REPAIR/SERVICE ORDER

TEL. (201) 755-7080
TWX: (710) 997-9553
CABLE: DRANETZ

NOTE: THIS COMPLETED FORM MUST ACCOMPANY RETURNED EQUIPMENT

CUSTOMER SHIPPING & BILLING INFORMATION

CUSTOMER P. O. # _____ P. O. DATE _____

SHIP TO: _____ INVOICE TO: _____

In Continental U. S., material will be returned by Dranetz to you by UPS, UPS Blue or other carrier chosen by Dranetz unless otherwise designated.

EQUIPMENT BEING RETURNED

Date of Original Purchase: _____ Original P. O. # _____

Model No. _____ S/N _____

Model No. _____ S/N _____

Ancillary equipment also being returned (If you neglect this, these items may not be returned to you).

☐ Power & Other Cables _____ ☐ Instr. Book _____

☐ Plug-ins (incl. S/N) _____ ☐ Connectors _____

☐ Other _____

RETURN AUTHORIZATION

Have you discussed the problem with Dranetz Sales or Service personnel?

Dranetz Return Authorization # _____

By: _____

If so, with whom _____ Date: _____

Whom should the Dranetz Customer Service Dept. contact for technical questions?

( )

NAME (Print) DEPARTMENT TELEPHONE

DESCRIPTION OF PROBLEM

Please be detailed, explicit and complete. Include test data, if this helps to describe the problem.
IMPORTANT: Repairs cannot be made unless this section is completely filled out.
(Attach added sheets if necessary)

CHECK WHERE APPLICABLE: IS MALFUNCTION RELATED TO: Warmup ☐ Temperature ☐

Intermittency ☐ Mechanical Handling ☐ Visual Defects ☐ Grounding ☐ Test Data Attached ☐

INITIATOR OF THIS ORDER

NAME/TITLE SIGNATURE TELEPHONE

(SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (ENCLOSE THIS ENTIRE FORM WITH EQUIPMENT)

INSTRUCTIONS FOR REPAIR ORDER – DRANETZ ENGINEERING LABS.

IMPORTANT: FOLLOW INSTRUCTIONS & USE THIS FORM. IT IS DESIGNED TO HELP US HELP YOU.

1. Before returning equipment to our factory, call our Customer Service Department, Tel: (201) 755-7080. Give the model No., serial number, and information on the problem.

   A. Our specialists may be able to solve your problem rapidly without equipment return.

   B. If equipment return is needed, you will be supplied with appropriate instructions and authorization information to expedite service.

2. If return is to be made,

   A. Fill out the other side of this form COMPLETELY.

   B. Enclose original of form INSIDE the shipping carton, preferably attached by masking tape to the equipment.

   C. Ship prepaid (including insurance); we will return prepaid unless otherwise advised by you.

   D. IMPORTANT - PACK PROPERLY! SHIPPING DAMAGE WILL BE CHARGED TO YOU!

NOTE:

Statement of Warranty - All products of Dranetz Eng. Labs., Inc. are warranted to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned, freight prepaid, during the warranty period, without charge for repair, provided there is no evidence that the equipment has been mishandled or abused.

FILL OUT OPPOSITE SIDE OF THIS FORM AND RETURN WITH EQUIPMENT.

INSTRUCTIONS FOR REPAIR ORDER – DRANETZ ENGINEERING LABS.

SECTION VI

PARTS LIST

6-1. SCOPE

The data in this section lists the parts required to support the Power Supply. Sufficient information is included to permit maintenance personnel to identify each maintenance part by part number, description, and supply source. Table 6-1 lists and identifies the manufacturer's codes referenced in the parts list.

TABLE 6-1. LIST OF MANUFACTURERS

Mfg. Code Ident.	Manufacturer
03508	General Electric Co., Semiconductor Products Dept., Electronics Park, Syracuse, N. Y. 13201
04713	Motorola, Inc., Semiconductor Products Division, Phoenix, Arizona
12040	National Semiconductor Corp., Commerce Drive, P.O. Box 443, Danbury, Conn. 06810
18324	Signetics Corp., 811 E. Argues Ave., Sunnyvale, Calif. 94086
23207	Dranetz Engineering Laboratories, Inc., 2385 S. Clinton Ave., South Plainfield, N.J. 07080
71400	Busmann Mfg., Division of McGraw Edison Co., 2536 W. University Street, St. Louis, Missouri 63017
80183	Sprague Products Co., North Adams, Mass.

TABLE 6-1. LIST OF MANUFACTURERS (cont'd)

Mfg. Code Ident.	Manufacturer
82389	Switchcraft, Inc., 5555 N. Elston Avenue, Chicago, Ill. 60630
50522	Monsanto, West Caldwell, N. J.
00124	Veeco, Plainview, N. Y.
25224	Globe Union, Inc., 5757 N. Greenbay Ave., Milwaukee, Wis. 53201
83330	Herman H. Smith, Inc., 812 Snediker Avenue, Brooklyn, N. Y. 11207
16758	Delco Electronics Division, General Motors, 700 E. Firmin St., Kokomo, Indiana 46901
04009	Arrow Hart, Inc., 103 Hawthorne St., Hartford, Ct. 06106
54453	Sullins Electronics Corp., P.O. Box 757, San Marcos, California 92069
81349	On MIL Spec List. Manufactured to meet Military Specifications. Available from a variety of sources.

REPLACEABLE PARTS LIST

Main Frame Assembly

Reference Designation	Part No.	Man. Code No.	Description
A1	103010	23207	PC Board
A2	103015	23207	PC Board
BT1	GC12	25224	Battery, 12V
C1	36DX851F200AC2A	80183	Cap., 850 uf, 200V
C10, C13	10TS-D10	80183	Cap., .001 uf, 1000V
C12	192P2249R8	80183	Cap., .22 uf, 80V
C14	36DX8D2G030AB2A	80183	Cap., 8000 uf, 30V
CR19-CR22	MDA-800	04713	Bridge Rectifier
DS1	MV5222	50522	LED, Green Discrete
DS2	MV5024	50522	LED, Red Discrete
F1	MDL-3 Amp	71400	Fuse, 3 Amp
F2	MDL-2 Amp	71400	Fuse, 2 Amp
J1	EAC-301	82389	AC Receptacle
J2	1280-103	83330	AC Receptacle
Q2, Q3	DTS403	16758	Transistor
Q12-Q15	2N5038	16758	Transistor
Q16, Q17	2N3055	16758	Transistor
R30	RC07GF100J	81349	Res. 10 ohms ± 5%, 1/4W

REPLACEABLE PARTS LIST

Reference Designation	Part No.	Man. Code No.	Description
R36	RW69V1RO-10%	81349	Res. 1 ohm ± 10%, 3W
S1	82612	04009	Toggle Switch, 3PST
S2	46206LFR	82389	Slide Switch
T1	103025	23207	Transformer, Power
T2	103026	23207	Transformer, Driver
T3	103027	23207	Transformer, Inverter
XA1	1SM15DREH	Sullins	PC Connector
XF1	HKP	71400	Fuse Holder
	PC Board A1		
C2, C15	10TS-T50	80183	Cap., 500 pf, 1000V
C3	39D158G025GP4	80183	Cap., 1500 uf, 25V
C4	500D105F200BB7	80183	Cap., 1 uf, 200V
C5	39D507G030FLY	80183	Cap., 500 uf, 30V
C6	10TS-D20	80183	Cap., .002 uf, 1000V
C7	10TS-S10	80183	Cap., .01 uf, 1000V
C8, C9	10TS-D50	80183	Cap., .005 uf, 1000V
C16	CS13BF105K	81349	Cap., 1 uf, 35V
CR5	1N753	81349	Diode, zener
CR7, CR8	1N4004	81349	Diode
CR9, CR10	1N4148	81349	Diode

REPLACEABLE PARTS LIST

Reference Designation	Part No.	Man. Code No.	Description
Q1	2N3055	81349	Transistor
Q4	2N2907	81349	Transistor
Q5-Q9,Q18	2N2222	81349	Transistor
Q10,Q11	D45C5	03508	Transistor
R1	RW74V680-10%	81349	Res. 68 ohms ± 10%, 5W
R3,R37	RC07GF101J	81349	Res. 100 ohms ± 5%, 1/4W
R5,R6	RW69V5R0-10%	81349	Res. 5 ohms ± 10%, 3W
R7-R9	RN60C3321F	81349	Res. 3.32K ± 1%, 1/8W
R10	RN75C1603F	81349	Res. 160K ± 1%, 1W
R11	RC07GF394J	81349	Res. 390K ± 5%, 1/4W
R12,R18, R24,R51	RC07GF103J	81349	Res. 10K ± 5%, 1/4W
R13,R43	3386P-1-202	81349	Var. Res. 2K
R14	RC07GF302J	81349	Res. 3K ± 5%, 1/4W
R15	RC07GF752J	81349	Res. 7.5K ± 5%, 1/4W
R16,R17, R26,R27, R31,R38, R39,R52	RC07GF102J	81349	Res. 1K ± 5%, 1/4W
R19,R22,R49	RC07GF223J	81349	Res. 22K ± 5%, 1/4W

REPLACEABLE PARTS LIST

Reference Designation	Part No.	Man. Code No.	Description
R20, R21, R23, R25	RC07GF472K	81349	Res. 4.7K ± 5%, 1/4W
R28	RC07GF271J	81349	Res. 270 ohms ± 5%, 1/4W
R40	RC07GF152J	81349	Res. 1.5K ± 5%, 1/4W
R41	RC07GF123J	81349	Res. 12K ± 5%, 1/4W
R42	RN60C3481F	81349	Res. 3.48K ± 1%, 1/8W
R46, R47	RC07GF272J	81349	Res. 2.7K ± 5%, 1/4W
R48	RC07GF124J	81349	Res. 120K ± 5%, 1/4W
R50	RC07GF684J	81349	Res. 680K ± 5%, 1/4W
R53	RW74VIRO-10%	81349	Res. 1 ohm ± 10%, 5W
U1, U3	LM723CN	12040	IC, Voltage Regulator
U2	NE555	18324	IC, Timer
	PC Board A2		
CR1-CR4	MDA-922-6	04713	Bridge Rectifier
CR6	1N4004	81349	Diode
CR15-CR18	1N4936	81349	Diode
R2	15E6	00124	Thermistor, 50 ohm
R32-R35	RW69VIRO-10%	81349	Res. 1 ohm ± 10%, 3W
R54	RC42GF431J	81349	Res. 430 ohm ± 5%, 2W
R55	RC07GF511J	81349	Res. 510 ohm ± 5%, 1/4W

SECTION VII

REFERENCE DIAGRAMS

This section contains the schematic and parts location diagrams (figures 7-1 through 7-3) of the Power Supply.

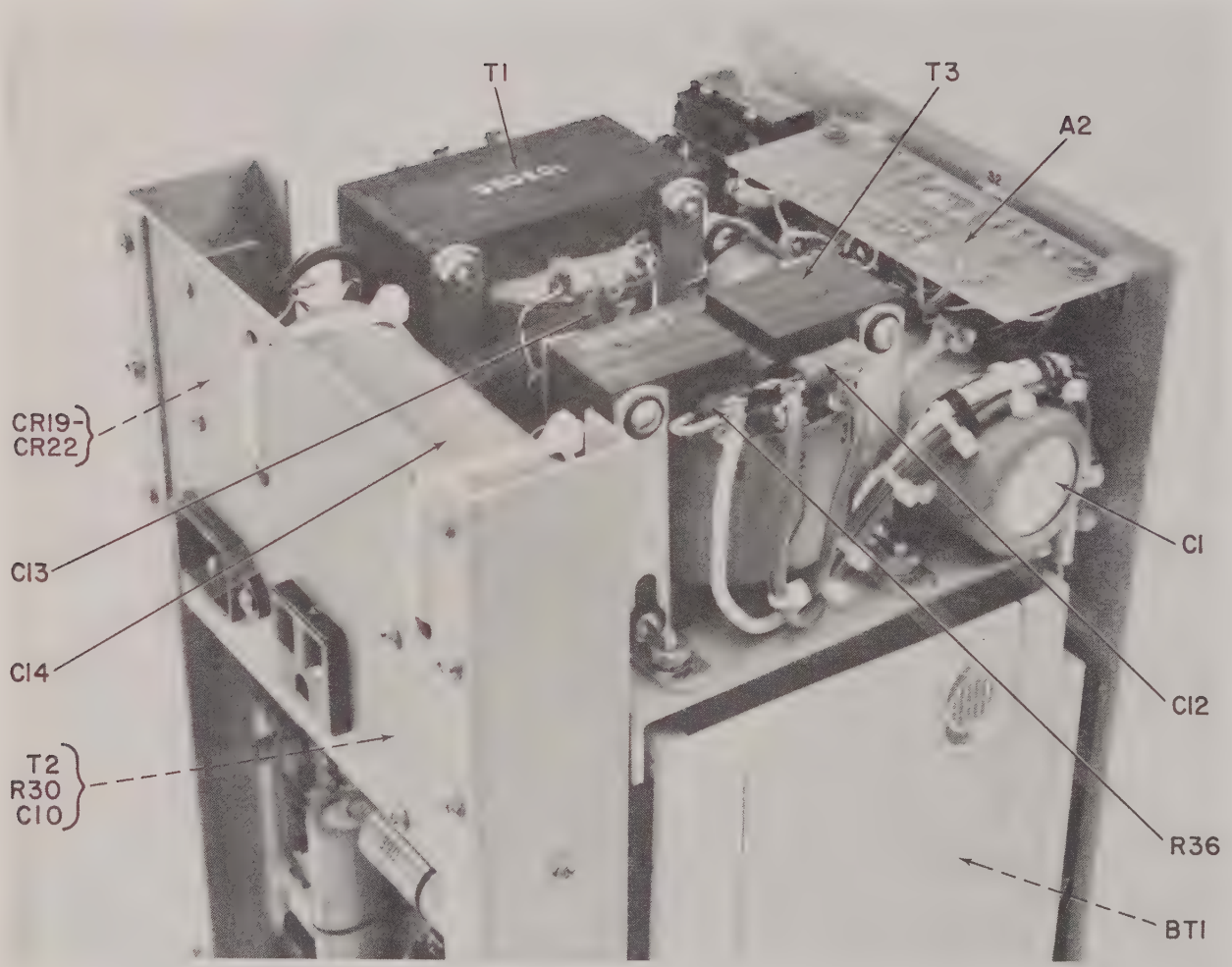


Figure 7-1. Upper View of Power Supply Chassis

REVISION INFORMATION

REV. C ON: REMOVED R4

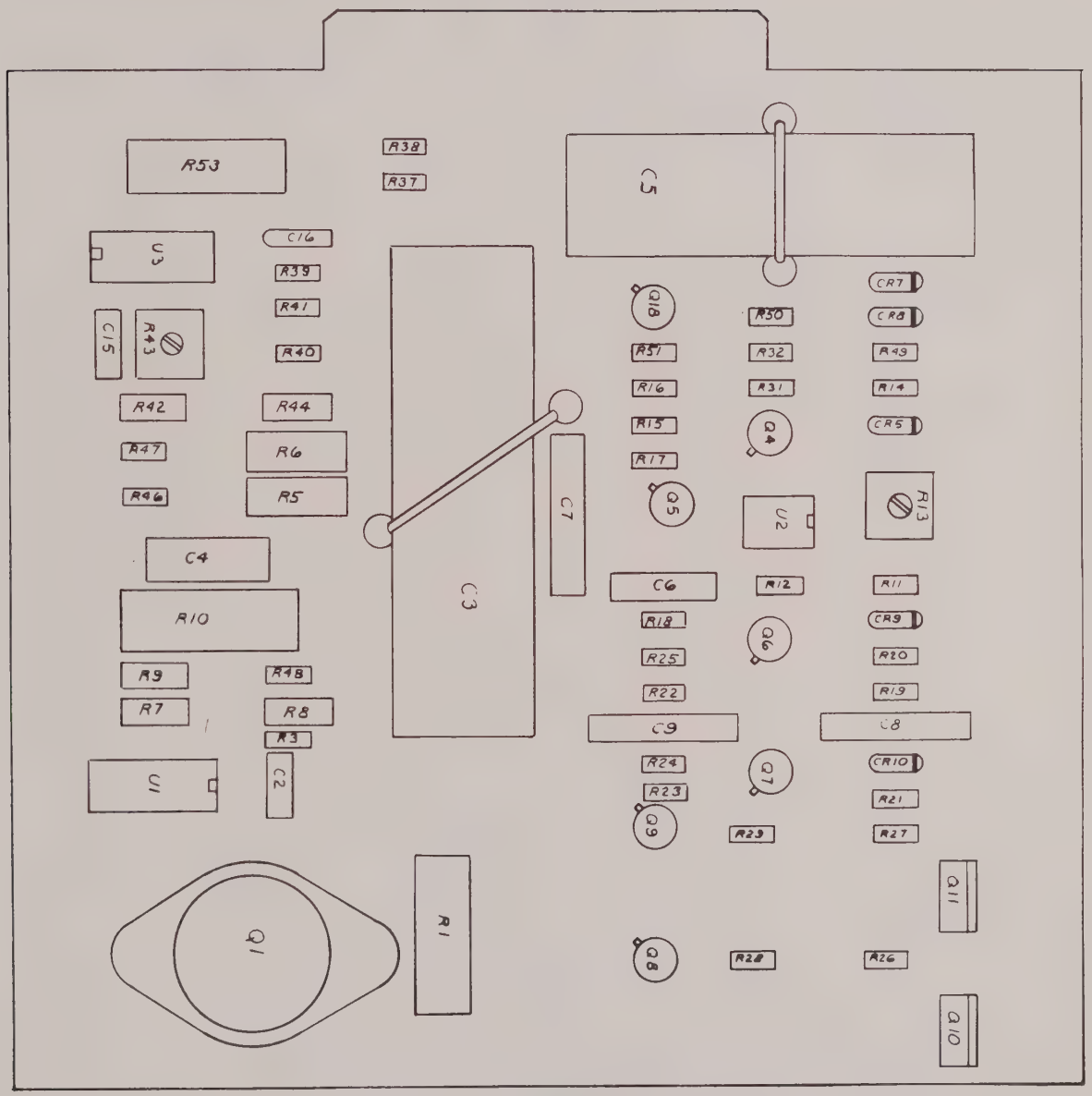
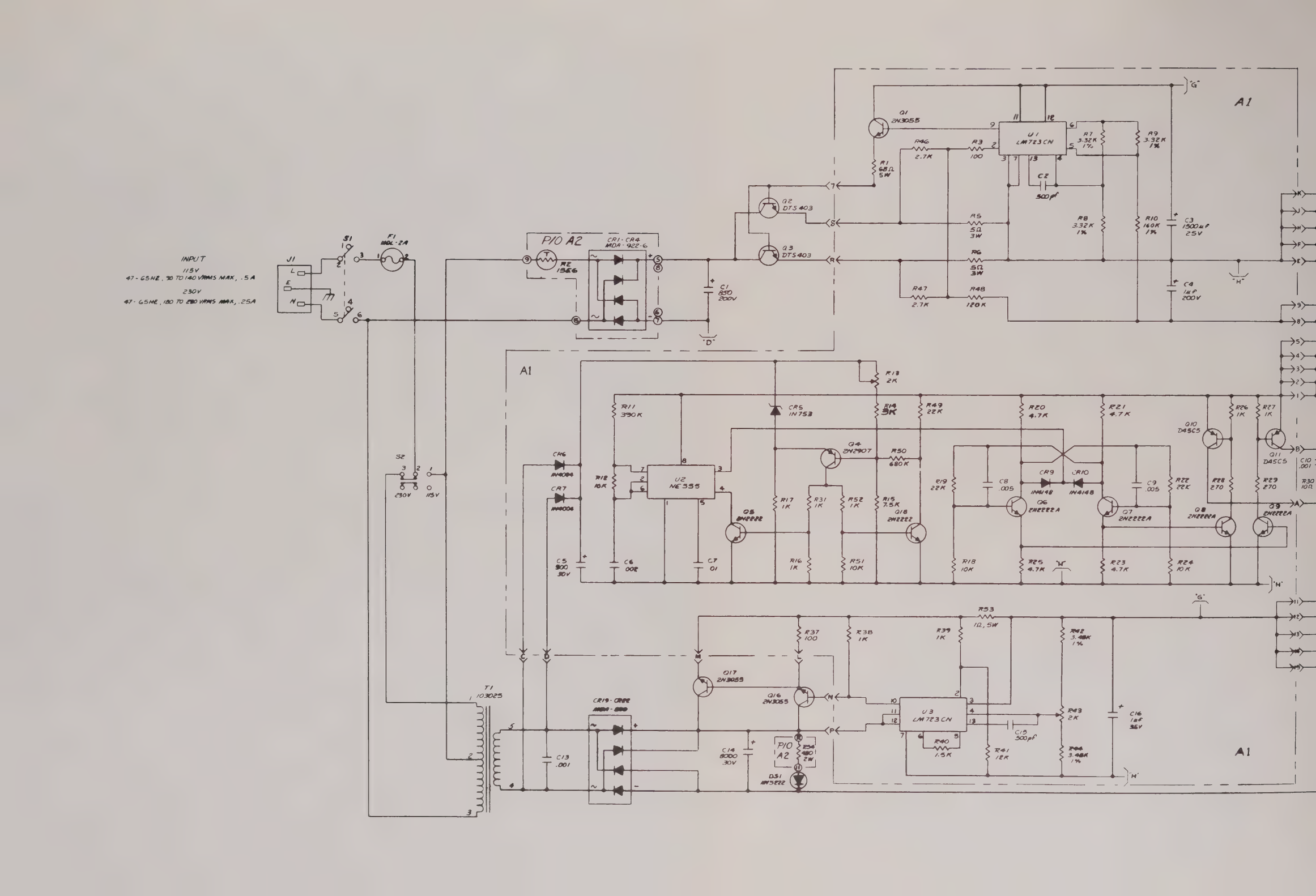


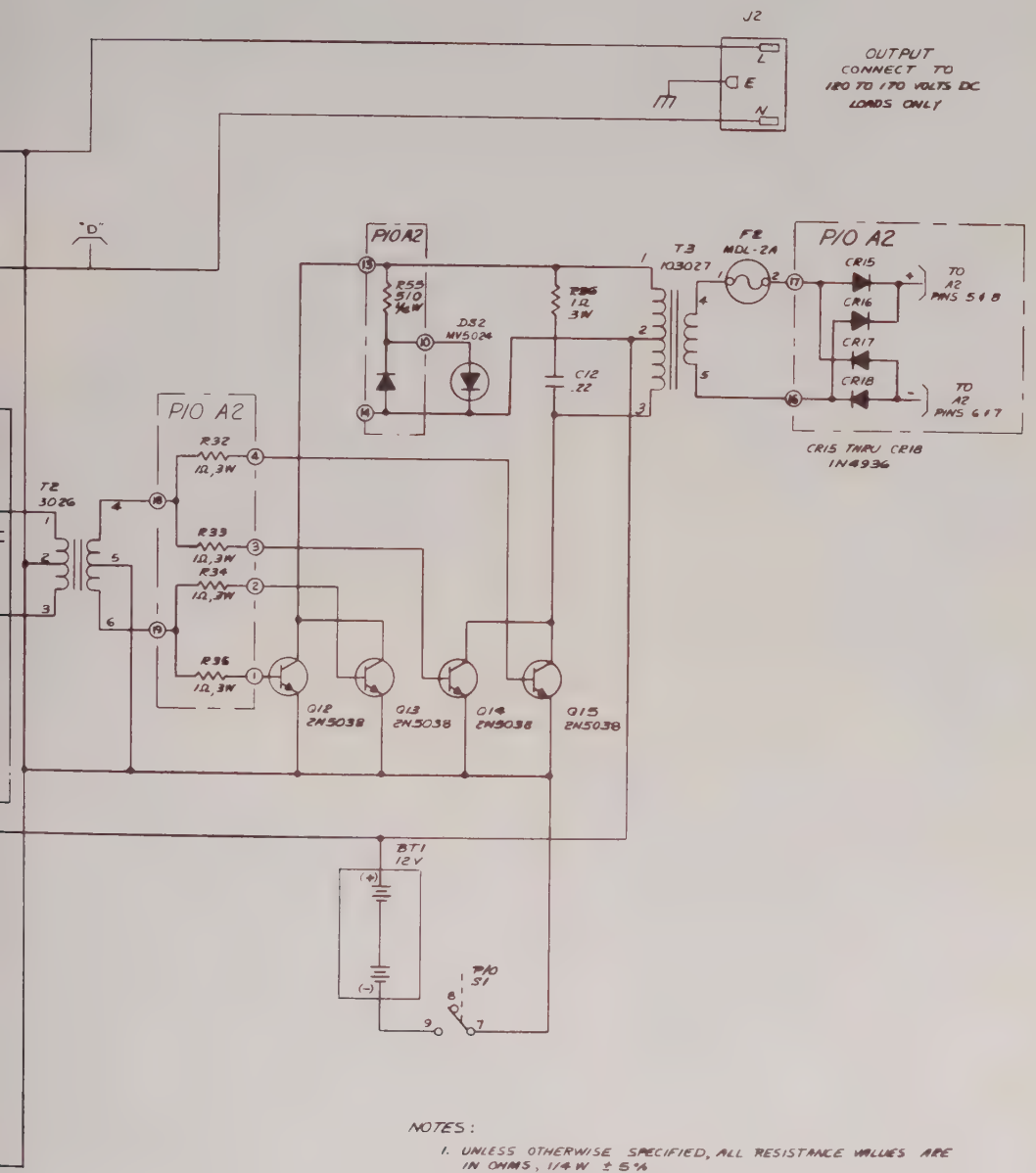
Figure 7-2. PC Board A1, Parts Location


INPUT
115V
47 - 65HZ, 90 TO 140 VRMS MAX, .5A
230V
47 - 65HZ, 180 TO 280 VRMS MAX, .25A
J1
S1
F1
MDL-2A
P/O A2
CR1 - CR4
MDA-922-6
RT
1566
C1
820
200V
Q1
2N3055
Q2
DTS 403
Q3
DTS 403
U1
LM723 CN
R1
68Ω
5W
R46
2.7K
R3
100
R7
3.32K
1%
R9
3.32K
1%
C2
500pf
R5
5Ω
3W
R8
3.32K
1%
R10
160K
1%
C3
1500μF
25V
R6
5Ω
3W
C4
1μF
200V
R47
2.7K
R48
120K
A1
R13
2K
R11
390K
CR5
IN753
R14
3K
R49
22K
R20
4.7K
R21
4.7K
Q10
D45C5
Q11
D45C5
R26
1K
R27
1K
Q4
2N2907
R50
680K
CR6
IN4004
CR7
IN4004
R12
10K
U2
NE555
CR9
IN4148
CR10
IN4148
R19
22K
C8
005
C9
005
R22
22K
R28
270
R29
270
Q5
2N2222
Q6
2N2222A
Q7
2N2222A
Q8
2N2907A
Q9
2N2222A
R17
1K
R31
1K
R52
1K
R15
7.5K
Q18
2N2222
C5
900
30V
C6
002
C7
01
R16
1K
R51
10K
R18
10K
R25
4.7K
R23
4.7K
R24
10K
S2
230V
115V
T1
103025
CR19 - CR22
MDA-980
R53
1Ω, 5W
R37
100
R38
1K
R39
1K
R42
3.48K
1%
Q17
2N3055
Q16
2N3055
U3
LM723 CN
R43
2K
C16
1μF
35V
C15
500pf
R40
1.5K
R41
12K
R44
3.48K
1%
C13
.001
C14
8000
30V
P/O A2
R54
680Ω
2W
D31
IN5222
A1

REVISION INFORMATION

REV. C ON: REMOVED R4, REVERSED CR9 AND CR10 POLARITIES. R55 CHANGED FROM 500 OHMS TO 510 OHMS.

REV. D ON: R14 CHANGED FROM 2.2K to 3K



NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS, 1/4 W ± 5%
2. UNLESS OTHERWISE SPECIFIED ALL CAPACITANCE VALUES ARE IN MICROFARADS.

Figure 7-3. Model 910 Power Supply, Schematic Diagram

DRANETZ

PRODUCT CATALOG

PRECISION INSTRUMENTATION FOR

- Phase/Gain
- Impedance
- Current
- Voltage
- Quality Factor Q
- Time/Frequency
- Power Line Disturbance
- Sequence of Events
- Harmonic Power

DRANETZ

Worldwide Leadership In Precision
Impedance/Phase/Power Instrumentation

INTRODUCTION

DRANETZ ENGINEERING Laboratories, Inc. is a leader in the design and manufacture of precision AC test instruments and systems. This equipment is widely used for measurement of impedance, admittance, transfer function, voltage, current and phase.

THIS CATALOG contains complete descriptions and specifications on many Dranetz instruments. With current price lists, this information is sufficient for specifying and ordering equipment. Additional information is often available, including application notes as well as Bulletins describing specific instruments and systems. These can be obtained by contacting our main plant or your local field representative.

DRANETZ EQUIPMENT utilizes the latest developments in the electronics state-of-the-art to provide the most advanced equipment with high quality at an economical price. Each instrument utilizes the latest in solid state and microcircuit components and, where possible, uses modular design. Flexibility and versatility are designed into these instruments at their concept. Computer compatibility is often available in standard instruments, and options can be provided for special requirements. In addition, the plug-in concept of these instruments assures exceptional flexibility.

OUR HIGHLY TRAINED FIELD AND PLANT ENGINEERS are readily available to assist you or supply you with additional information to enable you to meet your specific requirements. A telephone call will bring this service to you immediately without cost or obligation.

AFTER SALE SERVICE is an important reason for purchasing Dranetz equipment. Each instrument is warranteed for 1 full year after purchase. Dranetz maintains technical field representatives throughout the U.S. and in other countries, fully backed by in-plant experts. Wherever possible, application and service problems are solved on site. In addition, the company provides prompt and immediate service for equipment returned from the field. Frequently loan equipment is available for use during equipment repair.

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For information on products assigned Federal Stock Numbers (FSN) or available on Federal Supply Schedules (GSA) please contact factory.

DRANETZ

SERIES 305

SUPER PERFORMANCE PHASEMETERS AND GAIN/PHASE METERS*

305 Series Phasemeters provide the highest available accuracy, along with many operational features. Designed for the calibration laboratory, the design engineer's bench, the production line and automatic test systems, the 305 is the most widely accepted phasemeter in industrial, and governmental organizations. **

FEATURES

- No hands 86 dB dynamic range
- Automatic or programmable operation and calibration
- Highest accuracy — to 0.03°
- Repeatability better than 0.01°
- Rejects harmonics and noise
- Wide frequency range — 1 Hz to 11 MHz
- IEEE 488 Bus Compatibility

FLEXIBILITY THROUGH PLUG-IN CONCEPT

The plug-in concept of the 305 offers a wide selection of characteristics. Three standard mainframes and nine plug-ins are complemented by a variety of options, such as programmability, high speed and autocalibration. Special modifications are also available. In addition, modular construction throughout provides maintainability at both component and P.C. card levels for ease and speed of servicing.

WIDE FREQUENCY RANGE

The basic mainframe provides a direct frequency coverage of 2 Hz to 700 kHz with high accuracy. By the use of frequency converting plug-ins such as the 305-PA-3005, standard units can handle frequencies up to 11 MHz. Special units can be provided for higher frequency.

NO HANDS OPERATION

The Series 305 Phasemeters require no controls or adjustments by the operator. These units are also equipped with several significant automatic features. These include automatic selection of angle range, automatic sensing of leading or lagging angle, automatic selection of the output time constants, and automatic setting of AC gains.

HIGHEST ACCURACY

Accuracy to better than ±0.03° is attained with precision mainframes and carefully designed plug-ins. Mainframes exhibit precise zero crossing detection, angle-to-DC conversion linearity to approximately ±0.01° and outstanding DC stability. Plug-ins are designed for accurate conversion of sine wave (also square wave) inputs to square waves through carefully controlled amplifier circuitry, use of gain autoranging, and harmonic filters where necessary.

INSENSITIVITY TO INPUT LEVEL

Series 305 plug-ins are available with a guaranteed accuracy of better than ±0.05° even with independent input level variations of 60 dB. Typical accuracy can approach ±0.03° as shown on the following page.

NON-AMBIGUOUS ANGLE READINGS

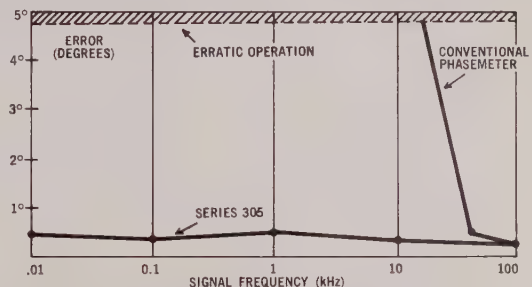
Two phase angle ranges in the 305 eliminate the ambiguity or "dead zone" error inherent in all other phasemeters (usually at 0°/360° or −180°/+180°). An automatic system switches to the 0°/360° range for angles near 180° and to the −180°/+180° range for angles near 0°. Unique guard bands prevent dead zones near switching points.

REPEATABILITY, STABILITY, AUTOCALIBRATE

Repeatability of the 305 is better than ±0.005°; temperature coefficient is ±0.001°/°C; and DC output drift is better than ±0.05° over any 30 day period. The autocalibrate feature eliminates virtually all DC errors in digital panel readout and BCD rear panel outputs.

NOISE IMMUNITY

Unique patented circuitry minimizes noise errors and makes possible accurate phase measurements under noise levels where other phasemeters become completely useless. The accompanying curve compares the phase error of the model 305 with that of a conventional phasemeter with broad band noise in both channels.



PHASE READING ERROR VS SIGNAL FREQ. FOR GAUSSIAN NOISE (FLAT TO 5 MHz) IN BOTH CHANNELS FOR S/N = 10

PROGRAMMABLE OPERATION

Standard mainframes are provided with rear connections for overriding the automatic time constant and angle range selectors by relay contact closures. Options are available for full compatibility with IEEE 488 Interface Bus and for control by DTL and TTL logic.

DIGITAL READOUT

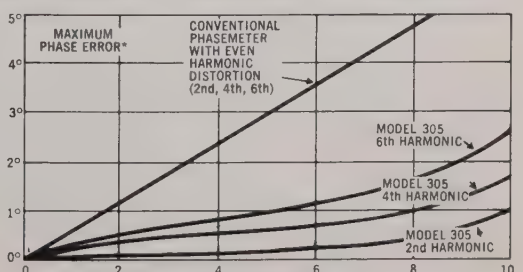
In addition to analog DC output, standard mainframes are available with up to 5 digit panel readouts (i.e., 0.00° to ±180.00° and 0.00° to +360.00°) and BCD outputs for each digit. Autocalibrate feature eliminates virtually all meter drift and scaling errors.

RAPID PHASE NULLING

For production testing of filters and other networks, an additional analog deviation-panel meter (305D) provides an easy means of adjusting a test angle to any accurate value. Presetting can be done in seconds without any other equipment. The precision digital panel meter monitors actual test angle continuously.

ABILITY TO REDUCE HARMONICS

The 305 is designed to reduce significantly the errors due to even harmonic distortion without the use of filters. The accompanying curve compares the error due to even harmonic distortion (maximized for worst case harmonic angle) on conventional phasemeters and on the model 305. (Odd harmonics in-phase with fundamental contribute no error.)



COMPARISON OF ERRORS DUE TO EVEN HARMONIC DISTORTION
(* For worst case phase relationship between harmonic and fundamental)

*Manufactured under U.S. Pat. No. 3,725,781
**For extensive application information, write for availability of "Applications Handbook of Precision Phase Measurement."

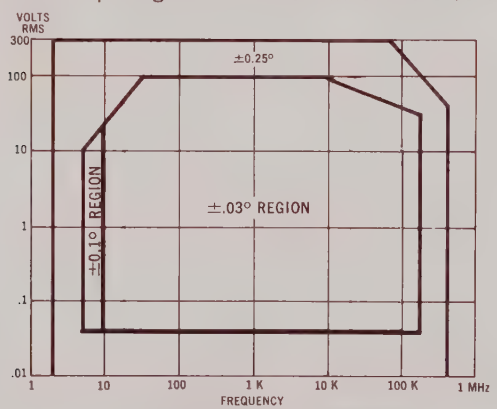
SERIES 305

SUPER PERFORMANCE PLUG-INS

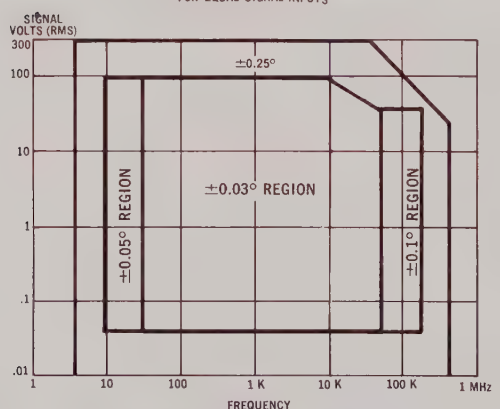
The variety of plug-ins available provides unlimited flexibility for the Series 305 Phasemeters in meeting many phase measurement problems. In addition to an expanding line of standard plug-ins, custom units can be designed for special needs.

305-PA-3001 AUTORANGING PLUG-IN

This plug-in features high accuracy over a broad range of input levels and frequencies. Autoranging of gain in each channel assures high accuracy (±0.05° guaranteed) over a dynamic range of 60 dB (50 mV to 50 V rms) for independent levels of inputs, with a useful range of 90 dB (10 mV to 300 V rms). This plug-in covers the range from 2 Hz to 700 kHz, with its highest accuracy in the 50 Hz to 50 kHz range. The curves shown illustrate typical accuracies as a function of level and frequency. The 305-PA-3001 also features compatibility with Tektronix probes and includes front panel lamps to indicate when either input signal is below 50 mV or above 50 V rms.



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR EQUAL SIGNAL INPUTS



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR UNEQUAL INPUTS — REF. 0.3 VOLTS RMS

While the above accuracies apply to sine wave inputs, this instrument can also be used for square wave and amplitude modulated signals.

305-PA-3002 SINGLE RANGE PLUG-IN

The 305-PA-3002 is similar to the model 305-PA-3001 except that it does not include autoranging or limit indicator lamps. For sine wave inputs the standard unit is designed for guaranteed ±0.05° accuracy (typically ±0.03°) over independent signal levels of 50 mV to 500 mV rms, with a slight reduction in accuracy from 10 mV to 3 V rms. Other level ranges can be supplied on special order; Tektronix probes can be used for high input levels. This plug-in is useful for sine wave, square wave and amplitude modulated signals.

305-PA-3005 HIGH FREQUENCY PLUG-IN

This high frequency plug-in is designed for high accuracy to 11 MHz. Using a self tracking oscillator, the input signals are converted to 40 kHz for precision measurement by the mainframe. Input attenuators (50 ohms) are provided with 10 dB steps, to cover a range of 1 mV to 3 V rms in either channel. Front panel lamps indicate when input levels are out of range or when level controls are improperly set. The self tracking oscillator can be controlled by channel A signal or by a third independent signal.

305-PA-3007 PROGRAMMABLE AND AUTORANGING PLUG-IN

This programmable plug-in features all of the characteristics of the model 305-PA-3001. In addition it includes increased input gain to achieve operation down to 1 mV rms. The unit can be operated either in an automatic or programmable mode. Without rear connections, the plug-in operates automatically as a 305-PA-3001; however, by utilizing rear connectors, the internal autoranging can be overridden and additional internal gain can also be inserted. Programming is available by DTL and TTL logic.

305-PA-3008 SINGLE FREQUENCY PLUG-IN

The 305-PA-3008 is a special purpose plug-in designed for precision calibration of 50 Hz, 60 Hz and 400 Hz power line equipment such as wattmeters, phase detectors and watt hour meters. This instrument can measure phase difference between two voltages, two currents or between a voltage and a current. The unit covers a voltage range of 25 V to 250 V rms and a current range of 0.1 to 5 A rms. The basic plug-in covers the frequency range of 50 Hz to 500 Hz. Plug-in filters, available for 50 Hz, 60 Hz and 400 Hz, assure reduction of second harmonic by at least 40 dB and higher harmonics by at least 50 dB. A front panel zero control provides adjustment for high accuracy (±0.1°) at any single frequency.

305-PA-3009 WIDE BAND NETWORK ANALYZER PLUG-IN (GAIN/PHASE/AMPLITUDE)

This plug-in measures the voltage amplitude of each signal input (in volts or dBV, selectable by operator), the phase difference between inputs, and the amplitude ratio of inputs. Featuring autoranging of gain in both channels, it requires no manual setting of gains for any measurement. Simultaneous DC outputs on mainframe are proportional to all four fuctions. A front panel switch selects the measuring mode for digital panel readout — channel A voltage, channel B voltage, phase difference, or amplitude ratio. Lamps on the front panel of the plug-in indicate the proper decade multiplier. The 305-PA-3009A is designed for extending the low frequency range.

305-PA-3010 SPECIAL PURPOSE PLUG-IN

This plug-in is typical of special purpose plug-ins which can be supplied to meet unique problems. Having high input impedance, it is equipped with closely matched low pass filters to pass 125 Hz signals while rejecting 400 Hz signals, solving problems in many types of servo control systems. Similar units can be readily designed for other special voltage and frequency applications.

305-PA-3015 PROGRAMMABLE PLUG-IN

Intended for use in automatic test systems, this plug-in has two selectable filters for harmonic rejection and selectable gains to handle inputs from 50 mV to 50 V rms. Filter (or filter out) selection as well as gain switching is accomplished by contact closures across terminals on the rear of the main frame.

PRECISION TRANSFORMER ISOLATION NETWORKS

Dranetz TR 3100 series networks are available for input voltage isolation with minimum phase error and flat gain response. For use with balanced or signal ended sources, these units are equipped with internal preamplifiers to produce outputs in the 30 mV to 3 V rms range (for use with 305 Series Phasemeters) for input levels from 50 mV to 500 V rms. These transformer units are packaged for direct plug-in into the input BNC's of the phasemeter, and draw B+ power from the front panel accessory connector of the phasemeter plug-in. Size: 2¾" x 2¾" x 2". Input: banana jack. Output: BNC.

Model TR——	Zin	Com. Mode Rej: >60 dB for frequency	Range for ±0.1° typical shift	Range for ±0.3° typical shift	Gain ±2%
3101	1 megΩ 70 pF	Below 1 kHz	20-400 V rms 50 Hz-20 kHz	5-400 V rms 10 Hz-25 kHz	x 0.01
3102	100 kΩ 70 pF	Below 10 kHz	2-40 V rms 50 Hz-20 kHz	0.5-40 V rms 10 Hz-25 kHz	x 0.1
3103	10 kΩ 70 pF	Below 25 kHz	0.2-4 V rms 50 Hz-20 kHz	0.05-4 V rms 10 Hz-25 kHz	x 1.0

MAINFRAME SPECIFICATIONS

Frequency Range: 2 Hz to 11 MHz (see plug-in data)

Angle Ranges: 0.00° to ±180.00° or 0.00° to +360.00° manually or automatically selected. End-of-range measurement errors are prevented by 15° automatic guard zones.

Analog Output
Range: −1.8000 to +3.6000 Vdc corresponding to measured angle; 10.0 mVdc per degree
Accuracy: See plug-in specifications
Output Impedance: 100 ohms

DC Resolution: Infinite
Linearity: Approx. ±0.01°
Repeatability: Better than ±0.005°
Time Constants: Automatically selected; 10 ms for frequency >5 kHz, 50 ms >500 Hz, 350 ms >50 Hz, 700 ms >2 Hz (Note: 4.6 time constants to respond to better than 99% of step change).
Warm-up Drift: Approx. 0.05° after first minute.
Long Term Drift: Typically less than ±0.05° per month
Temp. Coefficient: Approx. ±0.001°/°C
Recommended Output Devices: Recorders, DVM's, A-D Converters, Printers
Self Check: Front panel switches; dc outputs correspond to −180.00°, 0.00°, +180.00° and +360.00°
Error Rejection: False triggers due to high frequency noise are locked out for signal to noise ratios better than 10:1. Errors and fluctuations due to waveform dissymmetry or low frequency noise reduced by at least 10 to 1.
Harmonic Rejection: Worst case errors due to even harmonic distortion reduced by approximately 5:1 without filters. Odd harmonics in-phase with fundamental contribute no error.
Operator Adjustments: None.

Operating Temp. Range: 0° to +50°C
Grounding: Independent grounds for signal, chassis, and power line. (For safety, chassis and power line grounds connected at factory.)
Remote Programmability (standard on all mainframes): By rear connector pins. Override by contact closure of automatic time constant selection and angle range. Factory installed wiring from rear connector to plug-in for use with programmable plug-ins.
Modular Construction: Circuits on removable plug-in cards, extenders supplied for ease in servicing.
Size: 3½" high, 16" deep, 19" rack/portable package; shipping 22½" x 22½" x 6½".
Weight: 20 lbs. (9 kg.); shipping 30 lbs. (14 kg.).
Power: 115/230 V, 50-400 Hz, <0.75 A (specify voltage and frequency when ordering).
Plug-In Accommodation: Accepts 305-PA-( ) plug-ins. Mainframes and plug-ins are interchangeable.

ANGLE PRESENTATION

	Model 305	Model 305B	Model 305C	Model 305D
DIGITAL				
Display	None	4 digit plus sign	5 digit plus sign	
Angle Ranges	Not Applicable	0.0° to ±180.0° and 0.0° to +360.0°	0.00° to ±180.00° and 0.00° to +360.00°	
Resolution	NA	0.1°	0.01°	
BCD Output	None	BCD coded (1248), 4 lines per digit plus polarity line; TTL/DTL compatible (<0.8 V to > +2.4 V dc). Read and hold on command, and data ready features available on rear connector.		
Warm-up Time	NA	30 minutes (1 minute with option 107)		
Zero & FS Controls	NA	Front panel for FS & 0 (no adjustments with option 107)		
ANALOG				
DC Output	10.0 mV/°; 0.0000 V to 3.6000 V and −1.8000 V to +1.8000 V corresponding to 0.00° to 360.00° and −180.00° to +180.00°; infinite resolution.			
DC Offset	None		Continuously adjustable angle offset. Analog panel meter and DC output indicate deviation from offset.	

OPTIONS

#101 Rear connectors for signal and reference inputs, BNC[4]

#102 Full mainframe programmability; includes self check, angle range and time constant selection, DTL and TTL compatible.

#103 High speed analog output response. Time to respond to within 99% of step change: 1 ms for frequency >5 kHz, 10 ms >500 Hz, 100 ms >50 Hz, 1 second >5 Hz. (Temp. stability ±0.01°/°C)
(Opt. 103 not available with Opt. 107 or Mod. 14 below.)

#105 Remote zero control.

#107 Automatic calibration checks and automatically readjusts digital readout and BCD output circuits to reduce readout errors to ±0.02°. This option available only on 305C.

#110 Full compatibility with IEEE 488 Interface Bus. (Requires options 102 and 305-PA-3007 Plug-In.) This option available only on 305C.

Mod. 14 Higher accuracy below 12 Hz. Available only on 305B, 305C, and 305D.

COMBINED PLUG-IN AND MAINFRAME SPECIFICATIONS

MODEL	FREQUENCY RANGE	INPUT LEVELS (independent)	INPUT Z	ACCURACY[2] WITH INDEPENDENT LEVELS UNLESS OTHERWISE INDICATED Analog output accuracy: As specified below. Digital phase accuracy: For model 305C, same as analog accuracy. For model 305B, add ±0.1° digital readout error to analog accuracy specified.
305-PA-3001 Auto Ranging Plug-in	2 Hz to 700 kHz	10 mV to 300 V rms up to 10 kHz and to 50 V rms up to 700 kHz; can be extended to 40 kV rms with Tektronix probes. Each channel has automatic gain ranging, and lamps which indicate when level is below 50 mV and above 50 V rms.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 50 V rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 50 V rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3002 Single Range Plug-in	2 Hz to 700 kHz	10 mV to 3 V rms[1]; can be extended to 3 kV rms with Tektronix probes. Other ranges available on request.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 500 mV rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 500 mV rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3005 High Frequency Plug-in	200 kHz to 11 MHz	1 mV to 3 V rms; manual level controls in 10 dB steps. Lamps indicate when inputs are out of range or when level controls are improperly set.	50 ohms	Broadband with equal inputs above 10 mV rms: ±0.4° from 200 kHz to 4 MHz; ±1° from 4 MHz to 11 MHz. With independent levels above 10 mV rms: ±1° up to 4 MHz and ±2° up to 11 MHz. Single frequency — above 10 mV rms: ±0.3° at any frequency from 200 kHz to 11 MHz at any fixed levels.
305-PA-3007 Programmable and Auto-Ranging Plug-in	2 Hz to 700 kHz	Autoranging: similar to levels of 305-PA-3001. Programmable: overrides autoranging; extends low levels to 1 mV rms; DTL, TTL logic; program connector in rear of mainframe.	1 megohm shunted with 40 pF	Same as 305-PA-3001 for levels above 10 mV rms; typically ±0.35° from 50 Hz to 50 kHz for levels below 10 mV rms.
305-PA-3008 Power Freq. Plug-in	50-500 Hz without filters. 50 Hz, 60 Hz and 400 Hz L.P. filters available[3]	25 V to 250 V rms; 0.1 A to 5 A rms. Inputs are transformer isolated.	100 k ohm (voltage) 0.02 Ω max. (current)	At any single frequency, with filter set: ±0.1°, 25 V to 250 V rms, or 0.1 A to 5 A rms.
305-PA-3009 Network Analyzer (Gain/Phase/ Amplitude)	5 Hz to 700 kHz (Note: 305-PA-3009A operates to 1 Hz with 305 mod. 14)	10 mV to 40 V rms. Each channel has automatic gain ranging. Direct reading of phase angle, amplitude ratio and level of each input. Compatible with Tektronix probes.	1 megohm shunted with 40 pF	Phase: ±0.1° from 40 mV to 40 V rms from 50 Hz to 50 kHz; typically ±0.25° at all other levels from 5 Hz to 500 kHz. Voltage Amplitude: above 40 mV (channel A or B): ±2% reading ±0.03% FS, 50 Hz to 50 kHz; ±5% reading ±0.03% FS, 100 kHz to 500 kHz.[5] Ratio: ±0.5 dB, 50 Hz to 50 kHz; ±1 dB, 50 kHz to 500 kHz.[5]
305-PA-3010 Special Purpose Plug-in (with filter)	For use at 125 ±10 Hz; matched filters in both channels reject higher frequencies	500 mV to 5 V rms. Other ranges available on request.	1 megohm shunted with 40 pF	±0.1°, 500 mV to 5V rms; ±0.25°, 100 mV to 500 mV rms.
305-PA-3015 Selectable Filter Plug-in	5 Hz to 500 kHz without filters; uses 2 of type 305-PA-3008-( ) filters [3]; filter selection programmable	Ranges of 50-500 mV rms, 0.5 to 5 V rms, and 5-50 V rms selectable by remote contact closures.	1 megohm shunted with 40 pF	With filters, ±0.1° at fixed frequencies over all levels; without filters ±0.1° from 50 Hz to 50 kHz at all levels (typically ±0.03°), typically ±.25°, 5 Hz to 500 kHz.

[1] Can be provided for other voltage levels.
[2] For sinusoidal signal; can be used for square wave inputs over limited frequency range; can be used for amplitude modulated signals up to 97% modulation, depending upon model, level and frequency.
[3] 50 Hz filter, P/N 305-PA-3008-50; 60 Hz filter, P/N 305-PA-3008-60; 400 Hz filter. P/N 305-PA-3008-400. (Other frequencies available on request.)
[4] Available for use with 305-PA-3001, -3002, -3007 and -3010. Specify when ordering plug-in. [5] For higher accuracy below 50 Hz, specify Model 305-PA-3009A.

DRANETZ

SERIES 331

HIGH ACCURACY ECONOMY PHASEMETERS

- Accuracy to 0.05°, resolution to 0.01°
- Frequency range 5 Hz to 500 kHz
- Analog output and 4 or 5 digit panel readouts
- Input 0.05 to 220 V rms
- Accepts sine, square and other waveforms in either channel

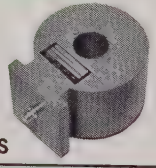
The Dranetz 331 Series Phasemeters feature high accuracy over a broad amplitude and frequency range. Front panel controls (equipped with LO/HI indicators) are used to select proper voltage ranges, as well as to check and adjust calibration. The 331 incorporates several of the important features of the Superperformance 305 Series, including elimination of 0°/360° ambiguity and reduction of sensitivity to noise and even harmonics. The 331 is designed for calibrating equipment, for testing subassemblies and for general laboratory work.

SPECIFICATIONS

CHARACTERISTICS	331B	331C
Frequency Range:	5 Hz to 500 kHz	
Accuracy: Sine Wave:	±0.1° ±1 digit from 50 Hz to 50 kHz, add ±0.2° per 100 kHz above 100 kHz and ±0.2° ±1 digit at 5 Hz.	±0.05° from 50 Hz to 50 kHz; ±0.2° from 10 Hz to 100 kHz; add ±0.2° per 100 kHz above 100 kHz.
Square Wave:	±0.1° ±1 digit from 10 Hz to 20 kHz;; ±.5° per 100 kHz above 20 kHz	±0.05° from 10 Hz to 5 kHz; ±0.1° to 20 kHz; ±0.5° per 100 kHz above 20 kHz.
Angle Ranges:	000.0° to 360.0° or −180.0° to +180.0° automatic or selectable.	
Input Signal Amplitudes:	0.05 to 220 Volts rms in 3 ranges (0.05-0.5, 0.4-5, 4-220; can be extended with Tektronix probes.	
Input Impedance:	1 megohm shunted by 50 pF nominal	
Analog Output:	0.0000 to 3.600 V and −1.8000 to +1.8000 V DC, +10.00 mV DC/degree phase; output impedance less than 100 ohms.	
Ambient Temperature	0°C to 45°C	
Panel Controls and Adjustments:	3 range input level pushbuttons each channel; read-hold; power; 0° cal and 360° cal adjustments.	
Power Requirements:	105-125 or 210-250 volts, 50/60 Hz, 70 watts.	
Dimensions:	3½″ high x 16″ deep, 19″ rack/portable package; 22½″ x 22½″ x 6½″ shipping; 18 lbs. (7 kg) net wt., 25 lbs. (10 kg) shipping.	
Option:	#101: BCD output, TTL/DTL, 8421 — #102: Rack Mount	#101: BCD output, TTL/DTL, 8421 — #102: Rack Mount

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 331

TR-2004 — TR-2005 CURRENT TRANSFORMERS



FEATURES

- Output voltage is faithful reproduction of input current
- Wide frequency and dynamic range
- Excellent pulse and phase response
- High voltage isolation
- 1¼″ D hole for primary

APPLICATIONS

- Testing sonar projectors and arrays
- High power immitance and transfer measurements
- Measuring transients in SCR's
- Measuring electron beam currents
- Current sensing in AC feedback systems

SPECIFICATIONS

CHARACTERISTIC	TR 2004	TR 2005
Sensitivity per Primary Turn (V rms/A rms)	0.1; +0, −1%	1.0; +0, −1%
Square Pulse Input		
Max. Current	10,000 A pk	1,000 A pk
Rise Time	For rise times > 1 microsec.	40 nanosec. approx.
Droop	10^{-4}%/microsec.	10^{-2}%/microsec.
Max. Amp-sec. per pulse	1	0.1
For Sinusoidal Input		
Amplitude Limit	100 A rms above 17 Hz; 9 A pk/Hz below 17 Hz; 90 A pk at 10 Hz	10 A rms above 100 Hz; 0.15 A pk/Hz below 100 Hz; 7.5 A pk at 50 Hz
Useful Frequency Range	0.25 Hz to 700 kHz	20 Hz to 10 MHz
Amplitude Response with Frequency +0%, −1% Limits		
Low Frequencies	4 Hz to 100 kHz	1 kHz to 4 MHz
	3 dB at 0.25 Hz	3 dB at 20 Hz;−3% at 200 Hz; −5% at 100 Hz
High Frequencies	3 dB up to 700 kHz; +2.5% at 300 kHz; +7% at 400 kHz	3 dB at 10 MHz
Phase Response ±0.8° Limit		
Low Frequencies	20 Hz to 100 kHz	1 kHz to 2 MHz
	1.5° at 10 Hz; 2.9° at 5 Hz	2° at 500 Hz; 4° at 250 Hz;
High Frequencies	1.5° at 200 kHz; 2.2° at 300 kHz	8° at 100 Hz; 13° at 50 Hz
		2.7° at 5 MHz
Electrostatic Shielding		
With 1000 volts rms at 5 kHz on primary, secondary output corresponds to less than:	10^{-4} ampere turns through primary	10^{-5} ampere turns through primary
Maximum Insertion Impedance	0.0002 ohms	0.02 ohms
Maximum Voltage	15 kV pk surface to high voltage; 30 kV pk with primary insulation	
Typical Primary Capacitance	6 pF in oil; 3 pF in air	
Recommended Load	> 10,000 Ω in parallel with < 20 pF	
Dimensions	(approx) 5″ OD x 1¼″ ID x 2½″ high plus mounting flange (4 mounting holes on flange: 3/16″ D on centers 1 3/16″ x 2½″)	
Connector	BNC	
Weight	4 pounds approx.	
Shipping Weight	8 pounds approx.	

DRANETZ

SERIES 325

POWER SYSTEM POLYMETER / DUAL MEASUREMENT OF VOLTAGE, CURRENT, TIME, FREQUENCY

FEATURES

- Simultaneous measurement and display of two selectable parameters.
- Display of continuous, triggered or maximum readings.
- Full isolation of all inputs.
- Precision measurement of time interval in seconds or cycles.
- Large 0.6″ digital display.
- Precision frequency measurement optional.
- Portable for field use.
- A field instrument with laboratory accuracy.

The Series 325 is specifically designed for measuring key parameters in electric power systems. Simultaneous measurements of Voltage and Current, 2 Currents, 2 Voltages, Current and Time, and Voltage and Time may be made. Readings may be taken on a continuous basis, or the meter may be triggered to "freeze" readings at a specific time. Time may be measured either in seconds or cycles of the power line frequency. Timing and trigger inputs may be actuated from type A or B dry contacts or by AC or DC voltages. Special circuits assure positive triggering on first contact and prevent simultaneous start/stop conditions. Options and adapters are available for DC current, DC voltage, fast frequency measurement, low pass filters and BCD outputs.

APPLICATIONS

- Ideal for electric utility use.
- Testing of trip points on overcurrent, overvoltage, undercurrent, undervoltage, and underfrequency relays.
- With Model 314 Phase Angle Meter, ideal for impedance relays.
- Precision measurement of frequency.

SPECIFICATIONS

Frequency Range: 47-450 Hz. (25 Hz available on request.)
AC Voltage: 15 mV to 1000 V RMS, 1.5, 15, 150, 600 V FS, transformer isolated, 5000 ohms per volt.
AC Current: 1.5 mA to 100 A RMS, 0.15, 1.5, 15, 100 A FS, transformer isolated, .001 ohms insertion resistance.
Time Interval (2 ranges): 0 to 999.99 seconds in .001 second increments. 0 to 9999.9 cycles in 0.1 cycle increments.
Trigger Inputs: (Start and Stop) Contact closure, DC step voltage change, or AC input.
Accuracies: V, I, for 57-63 Hz ±0.25% reading ±0.025% FS, for 25-450 Hz ±0.4% reading ±0.04% FS; Time, ±0.003% reading ± last digit.
Out of Range: Display blinks when level is too high.
Measurement Modes: Continuous, triggered, and "hold maximum."
Dielectric Test: 4250 V RMS to ground from V and I terminals. 1600 V RMS to ground from trigger terminals. (Per ANSI-C39.5.) Also meets SWC test.
Power Supply: 95 to 140 or 190 to 280 V RMS, 47 to 450 Hz, 20 watts, International Universal type connector.
Operating Temp. Range: 10°F. to 110°F.
Size: Portable, weatherproof, with cover 11″ L x 7″ W x 9½″ D; without cover 11″ L x 7″ W x 7″ D (Panel 11″ x 7″); shipping 11″ x 14″ x 18″.
Weight: 10 lbs. (5 kg.); shipping 17 lbs. (8 kg.).

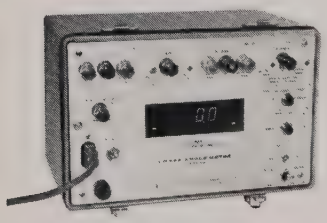
OPTIONAL FEATURES

Option 101: Fast frequency measurement capability — 0.1 sec. meas. time, 0.01 Hz resolution; 1 sec., .001 Hz resolution; accuracy ±0.002 Hz ± resolution.
Option Set 102 and 105: True RMS detection and low pass filters for removing effects of harmonics from measurements.
Option 103: BCD outputs suitable for driving printers for recording measured data. DTL/TTL compatible.
Option 107: Panel mount with remote display.
Option Set 108 and 109: Dry contacts corresponding to START/STOP times and accessory power for 325-PA-( ) adapters.
325-PA-1001: DC Current Adapter.
325-PA-1002: DC Voltage Adapter.
325-PA-1003: Contact Opening Trigger Adapter.
MR16-2 Rack Mount: 19″ rack plate and dust cover.

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 325

SERIES 314

POWER SYSTEM PHASE ANGLE METER / FOR ACCURATE & RAPID MEASUREMENT OF PHASE ANGLE IN ELECTRIC POWER SYSTEMS



FEATURES

- Universal Current-Voltage Inputs, V-V, I-I, V-I
- Portable
- Immune to Harmonics
- Independent of Frequency Changes
- Digital Readout — "No Hands" Simplicity
- Accuracy ±0.5°, Resolution ±0.1°
- Independent of Input Levels
- Complete input isolation

APPLICATIONS

- Testing and Adjustment of Protective Relays
- Measuring Load Current Phase Angles—Measuring Power Factor
- Testing Polyphase Balance
- Determining Power Flow in Interconnected Systems
- Minimizing Circulating Reactive Currents
- Synchronizing Multiple Sources

Accurate, precise and rapid phase measurement is an essential technique in the setup, operation, and maintenance of modern power systems, subsystems, and the control and protection circuits used in them. The value of a phase meter in such applications is directly proportional to the speed, convenience, and validity with which it indicates the phase angles it measures. With the introduction of the Dranetz Model 314, virtually all of the limitations and error sources of electromechanical meters have been removed, and the overall accuracy of this class of phase measurements has been increased by more than a full order of magnitude. The basic accuracy of ±0.5° specified for the Model 314 is actually **maintained, without degradation,** over the wide ranges of frequency variation, voltage/current level, and harmonic content for which the instrument is rated. Furthermore, the direct-reading **digital** presentation of phase, to four-place resolution (0.1° increments) requires no interpretation or interpolation, and is not subject to reading errors or parallax. **The phase angle you see is the phase angle that exists — to within ±0.5°,** without correction or uncertainty.

SPECIFICATIONS

ELECTRICAL

Range: 000.0° to 360.0°, Direct-reading
Frequency Range: 47-53, 57-63 Hz (specify at time of ordering)
Input Current Range: (both input circuits) .015-50 A rms
Input Voltage Range: (both input circuits) 0.3 to 600 V rms
Current-Input Impedance: Approx. 2 or 20 milliohms
Display: Four digits, non-flickering, 0.6″ numerals
Resolution: 0.1°
Accuracy: ±0.5°
Burden:
Voltage: 1.8 VA max. at 600 V rms input
Current: Approx. 2.5 VA at 50 A rms input
Interaction Between Inputs: None
Errors Due to Harmonic Distortion: None for harmonic distortion up to 30%, any harmonic
Errors Due to Offground Inputs or Reversal: None
Overload:
Voltage: 100% overload for 1 minute
Current: 100 A rms for 1 minute
Dielectric Test: Up to 2200 Volts rms between inputs and ground (ANSI-C39.5)
Self-Check: Provided for 000.0°. Full scale (360.0°) is autocalibrated internally
Power Required: 115/230 V, 50-60 Hz, 20 Watts

MECHANICAL AND ENVIRONMENTAL

Size: Portable, weatherproof carrying case with cover 11″ L x 7″ W x 9½″ D; without cover 11″ L x 7″ W x 7″ D (Panel 11″ x 7″); shipping 11″ x 14″ x 18″.
MR16-1 Rack Mount (optional): 19″ rack plate and dust cover.
Operating Temperature Range: 10°F to 110°F.
Weight: 10 lbs. (5 kg.); shipping 17 lbs. (8 kg.).

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 314

DRANETZ

SER SYSTEM 22
SEQUENCE OF EVENTS RECORDER

Ruggedly built for the power industry. Documents the activity of relays in substations, power generating stations, or industrial process control systems. Each input circuit senses a contact opening or closure. When such an event occurs, the time, state (alarm or normal), input number, and a user programmed alpha input description are printed. This data may be transmitted to a remote printer, supervisory control, or CRT via the recorder's RS232C interface.

The following printout is typical of information that is recorded immediately after a relay state change is detected.

Time of trip HRS:MIN: SEC:MSEC	*Current Status*	*Input #*	*Alphanumeric Description of Input*
17:02:45:020	*ALARM*	*0107*	*OC RELAY LINE 2*
	ALARM	*0050*	*DIST RELAY LINE 4*
17:02:45:021	*NORM*	*0711*	*BREAKER #1 LINE 1*

APPLICATIONS

- Aids in diagnosing system faults
- Pinpoints malfunctioning equipment in substations or power generating stations
- Portable unit allows the sequence testing of newly installed relay systems
- Provides operating personnel with an instantaneous indication of changes in system status

FEATURES

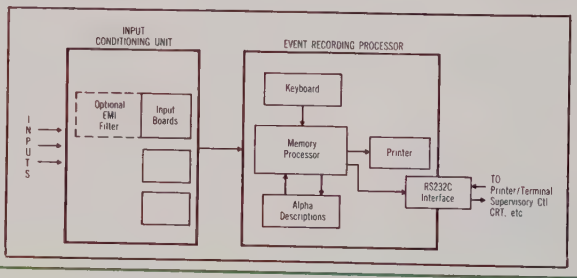
- 1 msec resolution • 32-1024 input capability
- Ongoing self-diagnostics — detailed diagnostic output
- Modular design • High noise immunity
- Instantly programmable solid state alpha description memory
- Portable or permanent installation
- Remote programmability
- RS232 interface permits transmission of output to remote printer, supervisory control, CRT, or annunciator

SYSTEM CONFIGURATION

The single panel Event Processor/Terminal (7" H x 19" W x 22" D) contains the processor, event and input description memory, power supplies and up to 32 input points. With the integral printer and keyboard-display option, you truly have a portable sequence of events recorder.

The system may be expanded through the addition of Input Conditioning Units (7" H x 19" W x 22" D) containing up to 64 inputs per panel (8 inputs/board with 8 boards/panel). A fully expanded system includes 16 additional input panels, for a total of 1024 inputs.

Two printer options are available. Model 2210PT incorporates an integral printer keyboard-display package. Model 2210P utilizes a separate terminal.



SPECIFICATION SUMMARY

System Power — 120 VAC primary power source. Automatic bumpless transfer to 125 VDC standard to insure continuous operation.

Inputs — Dry contact either normally open or normally closed programmable on a point by point basis. 1024 inputs maximum.

Input Boards — Input boards accept 8 inputs. Each input circuit provides optical coupling and analog/digital filtering of the input signal, 8 input boards plug into a 19" Input Conditioning Unit. Input boards are available for field contact voltages in the following ranges: 10-24 VDC, 40-90 VDC, 85-125 VDC, and 120-155 VDC.

Field Contact Voltage — Power may be supplied by the system's own optional power supply or by a user source such as the user's station batteries.

Resolution — 1 millisecond for up to 512 inputs and 2 milliseconds for up to 1024 inputs. For a 512 input system, events occurring more than 1 millisecond apart will be listed in the order in which they occurred with their event time to the millisecond. Events that occur within a millisecond duration will be considered to have occurred simultaneously.

Contact Bounce — 4, 8, 16, 32, 128, and 256 millisecond delays are available to eliminate multiple printouts due to contact bouncing. Delays are field selectable using a single jumper for the entire system.

Clock — Phase locked to line frequency with automatic transfer to crystal oscillator when voltage drops below 100 volts. Will synchronize to external pulse such as WWV. Pulse will be suppressed when events are in memory in order not to disturb the relative time differences between events in memory and events which may be occurring. If the unit contains the front panel printer, keyboard, and display, time will be continuously shown on the display unless the unit is being programmed.

Printer — Two standard printers are available, a free standing Dot Matrix Printer, and a thermal printer keyboard display combination located on the front of the Event Processor/Terminal. Printers are operative only when event information is being printed. A message is printed when paper is low. Return to normal messages may be suppressed. An inhibit print function allows events to be processed and retained in memory while paper is being replaced or printer is being repaired.

Event Memory — At least 113 levels of event memory is standard, expandable to 339 levels. This is a "worst case" value based upon one input per board changing state. Multiple inputs changing state on the same board within the same millisecond will use only one level of memory.

Alphanumeric Input Descriptions — 8, 16, 32 character alpha descriptions are available. Descriptions are stored on boards containing non-volatile, electrically alterable read only memory chips. Alpha capability may be added or expanded in the field. If the recorder is to be moved between two stations, a separate alpha description board can be programmed and plugged in when needed. Descriptions are input through the printer keyboard in an interactive mode with the recorder's processor. In the event the alpha board is inoperative, the numeric event data will still be printed.

Noise Immunity — Extensive analog and digital filtering, and shielding have been designed into both the Event Processor and Input Conditioning Units to attenuate conducted and radiated noise. An optional EMI filter board connected to the front end of an input board may be used in extra-ordinary high noise environments.

System Diagnostics — Ongoing self-diagnostics. The unit tests the majority of its hardware on an ongoing basis. Should a malfunctioning component be found, a descriptive message will be displayed and in some cases, the unit will take corrective action (i.e., if a defective input board is downgrading the performance of the system, it will be internally disconnected).

An optional ground fault detector — Trips on 5 mA to ground on either side of the power supply. An optional bank of switches isolates inputs, in groups of 32, to aid in determining which input is causing the ground fault.

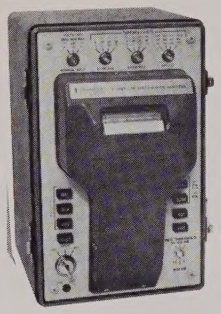
Single point test — The state of a designated input is changed, forcing the system to process an event. If the system finds it cannot process the event properly, a message is printed. This test may be programmed to occur hourly, daily, or may be initiated manually.

24 hour printout — At midnight, the system will update the time and date and print out a summary of inputs that are currently in alarm.

DRANETZ

SERIES 606*

POWER LINE DISTURBANCE ANALYZER/RECORDER



- For 115/230/460 V rms, 1 and 3 phase systems.
- Monitors, classifies, times and prints out line disturbances.
- Immediate and day-end printouts.
- Operates on command or disturbance — no wasted paper.
- For portable or permanent installation.
- 4 hour internal carry over power.

The 606 is designed specifically for monitoring power lines connected to computers, process control systems, hospital equipment and data communications devices, which are particularly susceptible to line transients, level changes or other disturbances. Using a digital microprocessor, the 606 classifies each disturbance into IMPULSE, CYCLE-TO-CYCLE CHANGE or SLOW RMS CHANGE. When preset thresholds are exceeded, the instrument prints out time, classification, magnitude, duration and channel designation. Data is also accumulated for overflow and day-end printout. The instrument is designed for unattended monitoring in a permanent installation or for temporary use at more than one site.

SPECIFICATIONS

Input Voltage Ranges: 115, 230, 460 V rms ±50%, all transformer isolated, Zin > 100 kΩ

Number of Inputs: Model 606-1, 1 input; Model 606-3, 3 inputs (3φ or separate circuits)

Test Modes:

AVG+ or AVG−: Increase or decrease in steady state rms, averaged over 10 sec

SURGE or SAG: Increase or decrease in cycle-to-cycle rms value

IMPULSE: 0-peak value of impulse (excluding line voltage waveform) having duration 0.5-800 μsec. Optional Adaptors (see below) measure strength, polarity and direction.

ACCUMULATED COUNT: Summation of disturbance data in memory (includes time, HI AVERAGE, LO AVERAGE, HI SURGE and number of HITS, LO SAG and number of HITS, HI IMPULSE and number of HITS)

Printing Modes:

AVG+ or AVG−: Prints time, AVG+ or AVG−, rms VALUE, CHAN., when exceeding threshold of 3, 5, 10, 15 V rms*

SURGE or SAG: Prints time, SURGE or SAG, rms VALUE, CHAN. and duration (cycles) when exceeding threshold of 3, 5, 10, 15 V rms*

IMPULSE: Prints time, IMPULSE, 0-pk VALUE (excluding line voltage) and CHAN, when exceeding 0-pk threshold of 50, 100, 200, 400 V. See below for additional information printed when Impulse Analysis Adaptors are used.

SUPPLY DOWN or UP: Prints POWER OFF or POWER ON and TIME

STORED DISTURBANCES: Stores data on disturbances during printing. Prints out when printer clears

ACCUMULATED COUNT (Short Term): Overflow of data entering printer. Prints out automatically

DAILY ACCUMULATED COUNT: End-of-day print out. Prints number of day and ACCUMULATED COUNT

TEST: Prints time and ACCUMULATED COUNT

RESET: Prints time and ACCUMULATED COUNT, resets memory

PRINT OFF: Prints PRINT OFF and TIME, disables printer, all data goes into accumulator for delayed summary printout

Accuracy:

AVG+ or AVG−: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

SURGE or SAG: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

IMPULSE: ±5% of reading ±1% of maximum impulse calibrated with a positive going, 10 μsec, half sinewave impulse. 6 dB bandwidth with half sinewave impulses: 800 μsec to 0.5 μsec

Clock: Indicates real time in hours, minutes, seconds, crystal controlled. During power off, operates on internal batteries (4 hours). Clock resets from front panel buttons

Printer: 18 character, alpha-numeric, thermal, paper 2¼" wide, prints 1 line/sec

Supply Power: 90 to 140 V rms, 45-450 Hz, 1φ, 1.0 A maximum (also DC operation 120-170 V maximum).

Case: Portable, removable cover with carrying handle.

Size (with cover): 11" H x 7" W x 9½" D; shipping 11" x 14" x 18".

Weight: 16 lbs. (7 kg.); shipping 24 lbs. (11 kg.).

Options: Opt. 101 (606-3 only), freq. disturbances; Opt. 102, 115/230 V supply power (switch selectable), 45-65 Hz; Opt. 103 (606-3, Opt. 101 only), monitors 400 Hz power lines; Opt. 104, external event indication; Opt. 105, enables use of Impulse Analysis Adaptors; MR15 Rack Mount Series, 19" rack plate and dust cover.

Model K103 Test Kit: Includes disturbance generator designed to verify operation of Series 606. Also includes a card puller, an extender card, and a set of programmed memories for assisting in calibration and troubleshooting.

Model 910 Uninterruptible Power Supply: For complete operation of 606 during power shutdown up to 2 hours. Fully protected from impulses to 1600 Volts, sags and surges of 50%, and total power interruptions.

Input (under normal conditions): 115/230 V rms nominal (switch selectable), 45-65 Hz, 1φ, 1.0 A maximum.

Output: 120 to 170 Volts, DC, 1.0 A.

Recharging Time: 18 hours.

Size: Portable carrying case same size as 606.

Weight: 35 pounds (16 kg.).

*These values for 115 V input; multiply by x2 or x4 for 230 V rms or 460 V rms.

SERIES 606-PA-(600X)*

IMPULSE ANALYSIS ADAPTERS FOR SERIES 606

Impulse Analysis Adapters supplement the analytical capabilities of the Series 606 Power Line Disturbance Analyzers by providing recorded measurements of **impulse strength**, i.e., the integral of impulse voltage with respect to time. The **strength** indicates the potential of the disturbance to damage or interfere with **sensitive** electronic equipment. Two of the four models in the Series also provide indication of the Polarity and Direction, i.e., from source to load or vice versa. These data are conveyed to the associated Model 606 (equipped with Option 105), for printing in conjunction with the information provided by the Model 606 itself.

* Manufactured under U.S. Pat. Nos. 3,549,874; 4,187,461; 4,206,413

SPECIFICATIONS

Function

606-PA-6001 Single-phase, 50/60 Hz; measures Strength only.
606-PA-6002 Three-phase, 50/60 Hz; measures Strength only.
606-PA-6003 Single-phase, 50/60 Hz; measures Strength, Polarity and Direction. Includes one current probe.
606-PA-6004 Three-phase, 50/60 Hz; measures Strength, Polarity and Direction. Includes three current probes.

Printed Information

Strength: Separates IMPULSE disturbances into six ranges of Strength. Prints appropriate range, i.e., >.001 V-SEC.
Polarity: Prints + or −.
Direction: Prints SRCE or LOAD.

Input Voltage Ranges: Same as Series 606.

Input Current Ranges: (Only applies to -6003 and -6004).

Max. at power-line frequency (47-63 Hz): 100 A. rms
Max. Impulse: 1000 A. Peak at 1 msec
Min. for Direction determination: 1 A. for at least 0.2 μsec

Current Probe Insertion Impedance: 0.4 mΩ at 60 Hz.

Steady State Power Requirements: Single-phase Adapters operate from power supply of associated Model 606. Three-phase Adaptors contain a separate power supply which requires 90 to 140 Vrms, 45 to 65 Hz, 1φ, at 0.25 A. nominal.

Option 102: Available on -6002 and -6004 to permit operation from 180 to 280 Vrms, or 90 to 140 Vrms (switch-selectable), 45-65 Hz, 1φ.

FOR FULL INFORMATION WRITE FOR BULLETIN 606

DRANETZ

SERIES 616*

DC/AC VOLTAGE DISTURBANCE ANALYZER

- Field troubleshooting
- Power supply analysis and testing
- Testing power conditioning equipment
- Monitoring battery voltages
- Simultaneous monitoring of AC and DC voltages

The Series 616 is a highly portable easy-to-connect analyzer for recording voltage disturbances on three channels: one AC and two DC. The Series 616 combines the outstanding features and operating techniques of the Series 606 (described on previous page) to record IMPULSES, SAGS and SURGES, and SLOW AVERAGE variations, when they occur, in an easy-to-interpret alphanumeric printout. The instrument is ideal for pinpointing the effects of AC input line disturbances on the DC outputs of power supplies in computers, communication equipment, and medical apparatus. Two models, the Model 616A for 4 to 25 VDC and the Model 616B for 8 to 50 VDC, are available.

* Manufactured under U.S. Pat. Nos. 3,549,874; 4,187,461; 4,206,413

SPECIFICATIONS

Input Voltage Ranges:* Channel A, 40 to 250 Vrms, 45 to 65 Hz; Channels B&C, ±4 to 25 VDC.

Test Modes

Impulse: Peak voltage of impulse after removing steady-state AC or DC voltage level. Impulse durations range from 0.5 to 800 μsec.

Sag/Surge: Sudden changes in steady-state voltage. Measurement interval equals one cycle of Channel A signal.

Slow Average: Slow changes in steady-state voltage. Measurement time constant is approximately 5 seconds.

Accumulated Count: Summation of disturbance data in memory (includes the number and worst case values of each type of disturbance on each channel since the beginning of the day).

Printing Modes

Impulse: Prints time, IMPULSE, 0-pk. value (excluding steady-state) and channel, when exceeding 0-pk. thresholds of 0.5, 1.0, 2.0 and 4.0 V* for DC channels, and thresholds of 50, 100, 200, 400 V* for AC channel.

Sag/Surge: Prints time, SURGE or SAG, voltage, duration (cycles) and channel when exceeding thresholds of 0.3, 0.5, 1.0, 1.5 V* for DC channels, and thresholds of 3, 5, 10, 15 Vrms* for AC channels.

Slow Average: Prints time, AVG+ or AVG−, voltage, and channel when exceeding thresholds of 0.3, 0.5, 1.0, 1.5 V* for DC channels, and thresholds of 3, 5, 10, 15 Vrms* for AC channel.

Supply Power: 90 to 140 Vrms, 45 to 65 Hz, 1φ, 1.0 A. maximum (also DC operation from 120 to 170 V).

Options: Opt. 101, frequency disturbances on channel A; Opt. 102, 115/230 V supply power (switch-selectable), 45 to 65 Hz; Opt. 104, external event indication; MR15 Rack Mount Series, 19″ rack plate and dust cover.

Model 604A-PA-1001: Adapts the Model K103 (described on previous page) for troubleshooting and calibration of the Series 616.

*These values are for Model 616A. Multiply by 2 for Model 616B.

FOR FULL INFORMATION WRITE FOR BULLETIN 616

MODEL 3100

SAMPLING NETWORK ANALYZER

FEATURES

- Measures Complex V, I, Ratio, Phase Angle and Power.
- Computes all Parameters Individually to 14th Harmonic.
- 1 Hz to 500 kHz.
- 1 mV to 300V Full Scale Ranges.
- Computes Magnitude/Phase or Real/Imaginary (Quadrature).
- High Accuracy: ±0.05% F.S., ±0.05% R, ±0.03°.
- Acquisition Time Down to One Cycle.
- Dual Channel with Auto-Ranging.
- RS-232C Interface Standard.
- IEEE-488 Bus Interface Available.

APPLICATIONS

Applications for the 3100 will be found where high precision phase, power and ratio measurements in the presence of high harmonic content, are common. The wide 70 dB dynamic range of the instrument, plus the high level of stability and reliability with state-of-the-art accuracy, make the 3100 truly unique in the network measurement world.

Aircraft, aerospace, and electronics applications are numerous. The 3100 provides a new accuracy dimension for ATE and GSE consoles, test set-ups for analog board testing, module and subsystem testing, vibration analyzers, and circuit and network analysis:

- Ground Support and Equipment Test
- Precision Power & Harmonics Analysis Measurements
- Vibration Analysis
- Communications Network Testing
- Sonar Pulse Testing
- AC Coupled Transfer Function Analysis
- Servo and Synchro Measurements
- R L C Measurements
- Line Fault Analysis
- ATE Consoles
- Filter Tests
- Amplifier Tests
- Oscillator and Crystal Testing

FOR FULL INFORMATION WRITE FOR BULLETIN 3100

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TP-102,999 The Power Problem — A 2-page reprint from **Computer Security** (Newsletter for Computer Professionals). July/August 1979. By Stephen J. Tharp, Dranetz Engineering Laboratories, Inc. and Aileen MacGahan, Chase Manhattan Bank.

TP-103,000 Impulse Strength Measurement: A New Technique for Analyzing Power-Supply System Performance Under Actual Field Conditions. Presentation to: International Telecommunications Energy Conference, November 27, 1979. Given by: Stephen J. Tharp and Philip Cox, Dranetz Engineering Laboratories, Inc.

AR-108001 Phase Meters — Applications from the Lab to the Stars (6-page reprint from **Electronics Test,** August 1979).

AR-108004 Sequence-of-Events Recorders Pinpoint T-line Fault Causes (4-page reprint from **Electric Light & Power,** February 1980).

AR-108005 Evaluating Power Line and Power Supply Performance in Computer Systems (6-page reprint from **Digital Design,** February 1980).

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All products of Dranetz Engineering Laboratories, Inc. are warranteed to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned to it, freight prepaid, during the warranty period, without charge, provided there is no evidence that the equipment has been mishandled or abused.

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